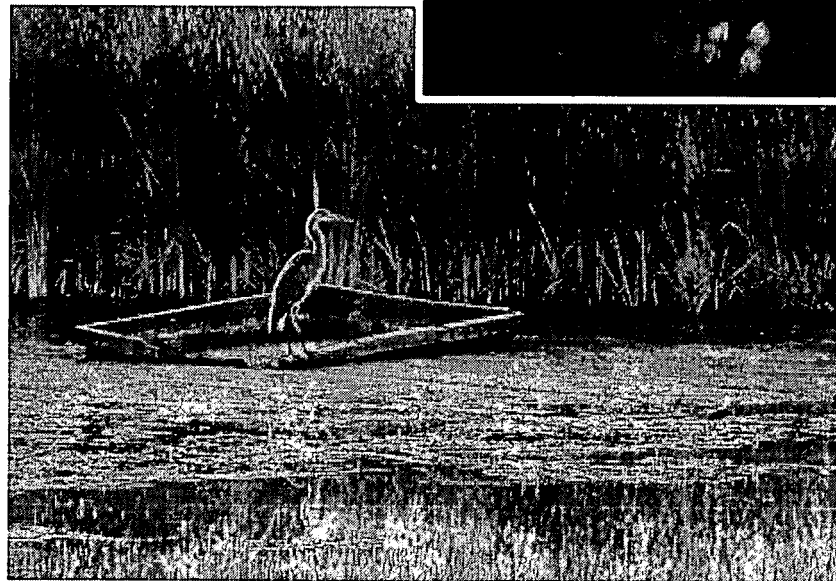
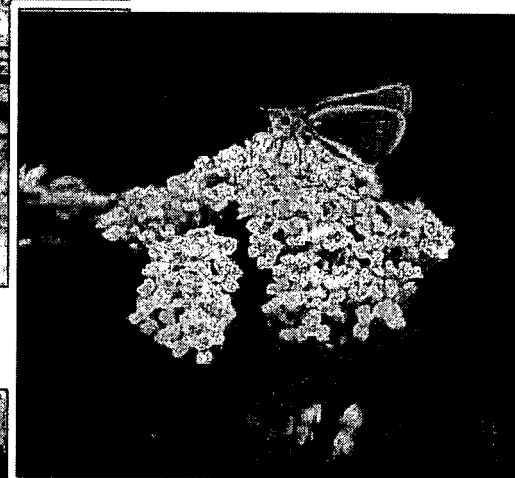


ECOLOGICAL

1999 Annual Wildlife Report for the Rocky Flats Environmental Technology Site



ADMIN RECORD

**1999 Annual Wildlife Survey
Report for the
Rocky Flats Environmental
Technology Site**

Kaiser-Hill, LLC
Rocky Flats Environmental Technology Site
Golden, Colorado 80402-0464

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Acronyms and Abbreviations

BEPA	Bald Eagle Protection Act
BZ	Buffer Zone
CDOW	Colorado Division of Wildlife
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CNHP	Colorado Natural Heritage Program
CWA	Clean Water Act
DOE	U.S. Department of Energy
ESA	Endangered Species Act
FNWA	Federal Noxious Weed Act
FWCA	Fish and Wildlife Coordination Act
IMP	Integrated Monitoring Plan
MBTA	Migratory Bird Treaty Act
NRCPP	Natural Resource Compliance and Protection Program
NRD	Natural Resource Damage
NTCA	Colorado Nongame, Threatened and Endangered Species Conservation Act
o/m	observations per minute
PIT	Passive Integrated Transponder
RFFO	Rocky Flats Field Office
Site	Rocky Flats Environmental Technology Site
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator

Executive Summary

Executive Summary

The Natural Resource Compliance and Protection Program monitors the status of wildlife, plant communities, and habitats to ensure that operations at the Site remain in compliance with state and federal wildlife protection statutes and regulations, and with U.S. Department of Energy orders. Other goals of the program are to collect sufficient data to provide a scientific basis for natural resource management decisions in keeping with established policies for the management of the Site, provide a basis for National Environmental Policy Act decision documents, and ultimately to provide data in defense of natural resource damage assessments upon completion of Site closure actions.

Species monitored under this program include big game mammals, large rodents and lagomorphs, migratory birds, carnivores, waterfowl, raptors, fish, herptiles (reptiles and amphibians), and special-concern species. No remarkable changes in population estimates, census data, monitoring results, or relative abundance of the species, or other measures were discovered through 1999 monitoring efforts. All data indicate that the majority of the ecosystem in the outer portions of the Site (the Buffer Zone) is not influenced substantially by actions within the Industrialized Area of the Site. As long as these habitats and plant communities remain undisturbed, and reasonable and prudent management actions are taken to maintain the health of the ecosystem, no significant adverse effects are likely to result from current Site operations.

New species recorded in 1999 included species from several different taxa. New bird species included the great egret, the orange-crowned warbler, and the black vulture, a species that previously has not been officially recorded in Colorado. One new mammal was the bushy-tailed woodrat, and for the first time, a snapping turtle was documented at the Site, although their presence had been rumored for several years. The list of species continues to increase by a few new species a year as long as qualified observers remain afield.

The most common big game species at the Site is the mule deer. The current population at the Site is estimated to be 140 to 150 individuals. White-tailed deer numbers have increased, and it is probable that there are more than a dozen of this species that use the Site with regularity. The age class breakdown continues to indicate a fawn survival rate of approximately one fawn for every two does (1:2). The number of fawns recorded in the year-end census (29) was equal to the mean of the winter fawn counts over the past six years. The doe-to-buck ratio continues to be very low (1.6:1), providing excellent breeding opportunity, and contributing to the stability of the Rocky Flats herd. Overall annual mule deer relative abundance of 0.12 observations per minute of survey (o/m) remained the same compared to previous years' data.

The most frequently observed carnivore species at the Site is the coyote, and the next is the raccoon. Coyotes, which are active both diurnally and nocturnally, were found in all

habitats. Annual sitewide relative abundance for coyotes has averaged 0.008 o/m over the past three years.

The presence of several mammalian carnivore species, the top species in the food chain, is an indication of the good ecological condition of the Site. While this program does not attempt to track the actual numbers of all carnivores at the Site, the evidence of a steady coyote population over time is a good indication that prey species continue to be abundant. The top carnivores in an ecosystem must have a large, healthy population of prey species upon which to subsist. Reduced numbers of prey species are normally reflected in reduced abundance and species richness of carnivores.

A total of 34 waterfowl species was observed during sitewide significant species surveys and multi-species census surveys. Seasonal assemblages of waterfowl species remained similar to previous years, with some previously observed species not recorded during 1999, and other species reappearing after an absence. This is not unusual with migratory species. A difference in timing of surveys by a day or two can yield extraordinary differences in numbers and migrating species present, depending on weather.

Raptor species exhibited their normal species richness and seasonal species assemblages. As in past years, red-tailed hawks, Swainson's hawks, American kestrels, and great horned owls nested in appropriate habitat across the Site, demonstrating that the habitat continues to provide the necessary resources for these species.

Fish sampling produced few surprises except that young smallmouth bass were recorded in Pond C-1. Otherwise, fish found in the ponds were limited to species known to be common on the Site in various areas. Fathead minnows were abundant, and largemouth bass were found to be still present in Lindsay Pond, although no other fish species was captured in that pond. Additional sampling by U.S. Fish and Wildlife personnel, who sampled stream riffles, did not produce observations of any new species.

In 1999, boreal chorus frogs were found at the same locations—except one—where they had been documented in 1998. At the exception location, only a few individuals had been calling in 1998, so hearing none in 1999 is not considered a cause for concern. At every other location, the vocalization indices were higher in 1999 than in 1998, indicating the continued presence and high abundance of boreal chorus frogs at the Site.

Preble's meadow jumping mouse monitoring in the Walnut Creek drainage produced some new information on Preble's mouse habitat. One mouse was trapped at the very top of the South Walnut Creek drainage, upstream of Pond B-1. Previous data had indicated that the mice probably did not travel far upstream from the B-4 Dam. This use of a new type of habitat along the pond margins caused Site ecologists to reevaluate, somewhat, their understanding of appropriate Preble's mouse habitat. The Preble's mice in Walnut Creek were shown, through radio telemetry, to have smaller home ranges than some that had been monitored in Rock Creek in 1998. Walnut Creek data from 1999 and Rock Creek data from 1998 were combined in a technique called "pooling," and population

estimates were calculated for the two drainages. The population estimate for the two drainages combined was calculated to be 112 (± 17) mice.

Migratory birds have shown various trends depending on season and monitoring methodology. Using multi-species census survey data to determine relative abundance showed that several species, though still in the top ten most abundant species, were in a slightly different order of abundance than in some previous years. This variability is not unexpected in migratory species. During 1999, 85 bird species were recorded on migratory bird surveys alone. This compares to a sitewide species richness of 194 species that have been recorded over the past nine years. Various statistical analyses performed on migratory bird survey data yielded variation similar to that of the relative abundance calculations. Overall, richness and diversity show only slight increasing or decreasing trends, and the variability normally associated with year-to-year differences in weather patterns. No significant trends in diversity, densities, or species richness—positive or negative—have been identified through these surveys; variations appear to be natural fluctuations.

The long-term, year-round ecological monitoring program conducted under this program continues to be an essential tool for identifying, describing, and quantifying fluctuations in wildlife populations, wildlife habitat use, and changes in the species that use the Site as year-round or seasonal habitat. Wildlife population densities vary constantly with natural pressures, and only well-integrated, long-term monitoring such as this can identify consequences of natural influences versus consequences of human activities. The data produced are an invaluable tool in predicting and avoiding ecological impacts resulting from projected human activities. Monitoring results can also guide the natural resource management decision-making process such that it continues to accomplish the goals of the Site's natural resource management policies. The continued development of this long-term database will provide a solid basis for defense against natural resource damage claims in the future, as well.

If sensitive species dwindle in numbers or disappear, a serious environmental health problem is indicated. Monitoring and surveys such as those carried out by this program can detect trends of this sort, and act as an "early warning system" for impending ecological problems. This function will become increasingly important as remediation activities at the Site increase, and will play an essential role in assessing natural resource damages.

Section 1

Introduction

1. Introduction

1.1 Background

Rocky Flats Environmental Technology Site (the Site) is a U.S. Department of Energy (DOE) nuclear industrial facility that has been part of the nationwide nuclear weapons complex since 1951. The Site is located in rural Jefferson County, Colorado, approximately 16 miles northwest of Denver, and 5 miles southeast of Boulder. The Site covers approximately 6,262 acres, of which approximately 5,900 acres forms an undeveloped Buffer Zone (BZ) around the central industrialized portion. The original 1951 land purchase included approximately 2,520 acres of rangeland, which was expanded by an additional 4,030 acres from private ranches in 1974 (some 290 acres were later allocated to the National Renewable Energy Laboratory). The Site adjoins undeveloped rangelands that are encroached by housing developments on the northeast and southeast. To the north, east, west, and northwest, public open-space lands border the Site. Figure 1-1 presents the general location of the Site.

The original mission of this DOE facility was the manufacture of nuclear weapons components. With the end of the Cold War and cessation of nuclear weapons production at the facility, the Site is currently undergoing cleanup and closure. During the next eight years, buildings will continue to be demolished, and disturbed areas will be planted back to native prairie. One of the current DOE goals is to preserve the Site's unique ecological resources. Indeed, in May 1999, DOE, Rocky Flats Field Office (RFFO) entered into an interagency agreement with the U.S. Fish and Wildlife Service (USFWS) that created the Rock Creek Fish and Wildlife Cooperative Management Area (Rock Creek Reserve) (DOE, USFWS 1999). The two agencies will jointly manage this Reserve to preserve the ecological resources within its boundaries. Over time, and as closure proceeds, the USFWS may assume joint responsibility for management of a larger area than that originally designated in the agreement. Certain natural resource protection goals are also identified in the Natural Resource Management Policy issued by DOE in 1998 (DOE 1998). Ecological monitoring is necessary to ensure regulatory compliance, to attain DOE's natural resource protection goals, and to preserve and protect these unique ecological resources to the maximum extent possible during cleanup and closure. The Natural Resource Compliance and Protection Program (NRCPP) provides for such ecological monitoring.

1.2 The Natural Resource Compliance and Protection Program

The NRCPP monitors the status of plant communities, wildlife, and habitats to ensure that operations at the Site remain in compliance with state and federal wildlife protection statutes and regulations, and with DOE orders. Other goals of the program are to collect

sufficient data to provide a scientific basis for National Environmental Policy Act (NEPA) documentation and to support cleanup and closure of the Site.

The regulatory drivers for NRCPP wildlife and habitat work include:

- The Endangered Species Act (ESA) (USC 1973b)
- The Fish and Wildlife Coordination Act (FWCA) (USC 1958)
- The Migratory Bird Treaty Act (MBTA) (USC 1973a)
- The Bald and Golden Eagle Protection Act (BEPA) (USC 1978)
- The National Environmental Policy Act (USC 1970)
- The Clean Water Act (CWA) (USC 1977)
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USC 1980)
- The Federal Noxious Weed Act (FNWA) (USC 1975)
- CFR Part 1022, Compliance with Floodplain/Wetlands Environmental Review Requirements (CFR 1979)
- CFR Part 230, 404(b)(1), Guidelines for Specification of Disposal Sites for Dredged or Fill Material (CFR 1980)
- The Colorado Nongame, Threatened and Endangered Species Conservation Act (NTECA) (CO 1991)
- Executive Order 11990, Protection of Wetlands (EO 1977a)
- Executive Order 11988, Floodplain Management (EO 1977b)

Since the Natural Resource Compliance and Protection Program (NRCPP) was established in 1992, Site ecologists have conducted routine surveys to monitor the health and populations of high-visibility and sensitive wildlife groups such as migratory birds, game species, indicator organisms (e.g., raptors and amphibians are groups that are more sensitive to contaminants and stress), and species that are afforded special protection by federal and state statutes. The methods used are set forth in the Site's standard operating procedures, *EMD Operating Procedures Manual Volume V* (DOE 1994a). Continuation of this program as a long-term monitoring program has provided a continuous record of these selected species that can be compared among years. These long-term surveys were the basis of Chapter 5, Ecological Monitoring, of the *Rocky Flats Environmental Technology Site Integrated Monitoring Plan* (IMP) (K-H 1998a). Each year the IMP is reviewed, and special sampling and monitoring may be added to address specific questions or additional data needs. This ongoing monitoring program is an important environmental management tool for DOE, RFFO and its contractors. Data from these surveys, which are archived in the Site ecological database, have been used in the

preparation of compliance documents, environmental evaluations, remediation plans, environmental assessments, environmental impact statements, categorical exclusions, and project planning documents. These data are also used to make ecological resource management decisions to ensure the preservation of these resources at the Site.

Routine monitoring provides data on habitat affinities of sensitive species, which can then be used to predict the presence or absence of such species within planned work areas, avoiding the expense of additional special surveys. Availability of such information allows timely assessment of proposed actions for potential ecosystem impacts, thus reducing project delays. These data are therefore a valuable planning tool that can help avoid conflicts between project scheduling and protective regulations. Monitoring also provides data for management decisions under the *Ecological Resource Management Plan* (K-H 1997a) and *Natural Resource Management Policy* (DOE 1998). Continued monitoring of wildlife populations at the Site will also provide valuable background data for addressing CERCLA-related Natural Resource Damage Assessment (NRDA) concerns in the future.

The NRCPP ecological monitoring program also supports documentation and protection of threatened and endangered species to comply with the ESA and NTECA, and addresses migratory bird protection concerns under the MBTA at the Site. The NRCPP project-specific surveys are performed in work areas before such activities as construction, mowing, assessment, remediation, and other projects start, and are instrumental in keeping Site activities in compliance with the acts and regulations listed above. Site-specific monitoring also provides data continuity with routine monitoring results.

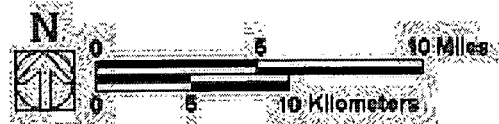
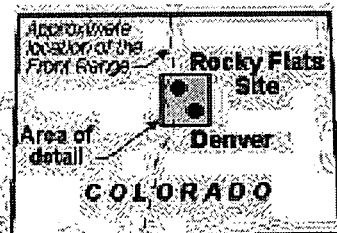
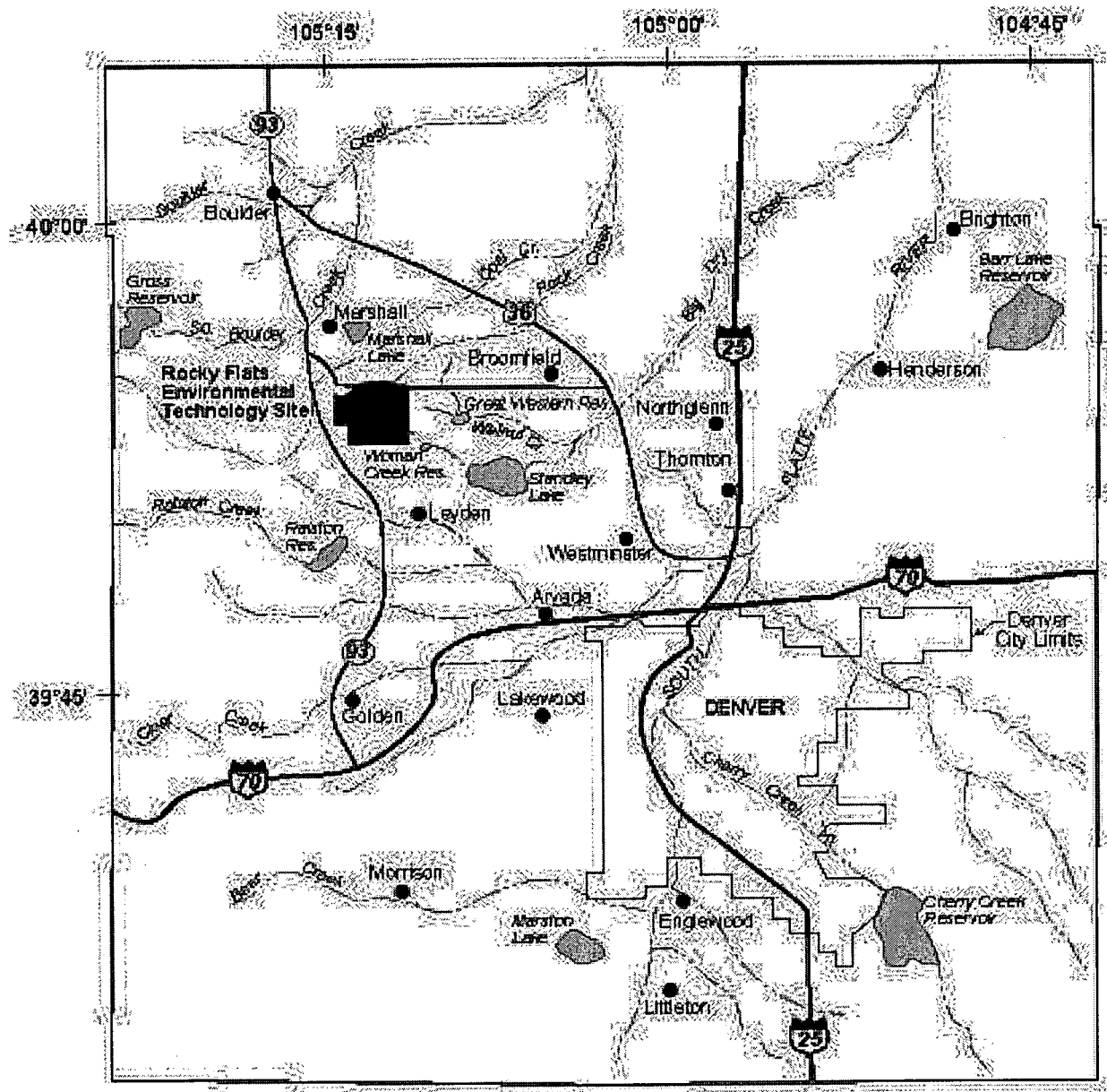
A long-term ecological monitoring program such as the NRCPP ecological monitoring program plays an essential role in identifying fluctuations in wildlife populations, wildlife habitat use, and changes in the species that use the Site as year-round or seasonal habitat. Wildlife population densities can vary because of natural or artificially induced pressures, and only long-term monitoring can identify "real" changes. If changes are found to be real, focused monitoring can then be implemented to determine whether these changes are the consequence of natural fluctuations or human influences. This information is essential for effective ecological resource management at the Site. The NRCPP also has the flexibility to add special surveys as needed for specific projects. Existing data in the database can then be combined with results from special surveys and analyzed to answer specific questions on ecological concerns. Availability of accurate, up-to-date ecological data is essential for planning long-term cleanup strategies. Additionally, advance knowledge of ecological concerns can help to avoid or minimize natural resource injury, thereby reducing liability for natural resource damages and establishing further credibility with regulators and the private sector.

Protection procedures and plans (DOE 1994b,c, 1997) developed and implemented by the NRCPP aid ecologists in assessing potential impacts to threatened, endangered, and special-concern species, as well as migratory birds and wetlands, all of which enjoy special protected status. Surveys performed in compliance with these procedures ensure

that wildlife and wetlands are protected, and that state and federal wildlife and habitat protection statutes are not violated during Site activities.

The purpose of this ongoing, long-term program is to monitor specific habitats, replicated as much as possible across the breadth of the Site, to provide a sitewide database from which to monitor trends in the wildlife populations at the Site. This type of monitoring program provides localized information that that can also be used for analyses at a landscape level, to monitor the population trends and general health of the Rocky Flats ecosystem. The landscape-level approach—that of examining the entire Site as a single ecosystem unit—provides the level of information required for effective natural resource management at the Site in general. This combination of local, combined with landscape, data interpretation allows identification of larger site-wide trends within the major habitats, so that the effects of general Site operations can be assessed and management actions can be identified. Because most groups monitored include highly mobile species, this larger-scale monitoring approach provides more complete information on population and use trends. Many species, or groups of species, use the entire Site or cross from one major drainage basin to another during various seasons, indicating that contiguous habitat units are of greater importance than drainage divides or artificial administrative divisions on the Site.

This report summarizes the results from wildlife surveys performed during 1999. Many survey techniques were used to determine populations and habitat use of wildlife species at the Site. The methods are outlined in the following section, and summaries of survey results for each major wildlife group monitored are presented in subsequent sections.



Section 2

Methods

2. Methods

Site ecologists use several methods to monitor the presence of wildlife, habitat use, seasonal residence, species densities, breeding areas, and other pertinent wildlife parameters. Significant species observations are recorded by grid location (Figure 2-1), whether observed during the sitewide significant species survey, multi-species census surveys, or migratory bird surveys. Multi-species census surveys, performed on established transects, record all wildlife observed. Monthly sitewide surveys along established roads over the entire Site record all significant species. Project-specific work-area surveys record the presence or absence of any special-concern species and confirm the presence and/or locations of wetlands within project areas. Migratory bird surveys record bird species along established transects. A limited fish sampling effort and an amphibian call-count survey are also part of the monitoring program. In addition to these formal surveys, fortuitous sightings of any significant species are recorded (these may occur during the above surveys).

2.1 Data Collection

2.1.1 Significant Species Data Collection

Significant species are species of special interest because of their status as high-visibility species, indicator organisms, sensitive species, federal and state protected species, or game species. Significant species groups include waterfowl, big game mammals, game birds, carnivores, raptors (birds of prey), small game mammals, furbearers, and selected other species. When observations of significant species are made, location data are recorded by grid-cell code (Figure 2-1). The alphanumeric grid-cell locator code (e.g., 12H) provides a location to within 1,000 ft of the observation. A list of species currently designated as significant is presented in Appendix A.

2.1.1.1 Multi-Species Census Surveys

Multi-species census surveys are performed monthly on 16 established survey routes, allowing long-term data collection on survey transects included in the NRCPP ecological databases. Monthly performance of these surveys allows collection of data to characterize habitat and area use and estimate the relative abundance of significant species year-round. Transect routes vary in length (generally at least a mile) in all major habitat types at the Site. The major habitats recognized at the Site include wetlands, riparian (streamside) woodland, riparian shrubland, tall upland shrubland, mesic mixed grassland, xeric mixed grassland, and reclaimed grassland. Table 2-1 presents a list of transects and habitat descriptions for the multi-species surveys. See Figure 2-2 for transect locations.

Multi-species census surveys are performed in accordance with procedures described in the *EMD Operating Procedures Manual Volume V* (DOE 1994a). Surveys are performed by a qualified ecologist who walks established transects in specific habitats and records data for all animal species observed during the survey. Multi-species census surveys are designed to collect data on species richness, species abundance, area use, and habitat use. Data recorded include species, number of individuals, habitat, activities, age and sex classifications, and other pertinent information. Additionally, the habitat use per minute of observation time is recorded. These data provide information on what habitats were used by which species, how often, and for what purposes.

2.1.1.2 Sitewide Significant Species Surveys

Sitewide significant species surveys are conducted monthly along all main roads in the BZ. Preference is given to fair weather to optimize observation ability and driving conditions. During these surveys, all visible individuals of significant species observed during a short time span (i.e., 3 to 4 hours) over the entire property are recorded. These surveys are performed diurnally (during the day) and nocturnally (during the night).

In 1999, diurnal sitewide surveys were performed monthly, except in August, when the monthly survey was nocturnal (dusk to midnight). The nocturnal survey method provides coverage over the entire BZ in areas that can be seen with the beams of hand-held spotlights. The primary purpose of the nocturnal survey is to document the presence of nocturnal species that are rarely observed during daylight hours.

2.1.1.3 Fish Sampling

In 1999, fish sampling was performed in all Site ponds. Sample locations were selected such that trapping occurred near inlets, along shorelines, and near dams.

Traps remained at each location for two consecutive days and were checked by afternoon of each day. Any aquatic or semi-aquatic vertebrates captured in the traps were identified and enumerated before being released.

2.1.1.4 Amphibian Monitoring

The methods used for the amphibian vocalization surveys in 1999 generally followed the guidelines provided in Mossman et al. (1998, pers. comm.). Additional information used for the surveys was taken from guidelines published by the Wisconsin Department of Natural Resources (Mossman and Hine 1984, 1985) and the National Biological Survey (NBS 1997). Some modification of these guidelines was necessary to adapt the surveys to local conditions at the Site.

Based on advice from Mossman (1998, pers. comm.), monitoring was conducted once in 1999 for boreal chorus frogs, with the nights for sampling selected subjectively. A pre-

sampling evaluation of boreal chorus frog vocalizations was conducted so that actual monitoring was conducted during the time frame in the spring when the frogs were known to be calling. Twenty locations, divided almost evenly between the north and south Buffer Zone areas (using the east and west access roads as the dividing line between north and south), were sampled for species presence/absence and population abundance in 1999 (Figure 2-3). Monitoring was conducted in the north and south Buffer Zones on two separate nights to keep the total sampling time each evening within two hours of sunset. Sampling in 1999 was conducted in the north Buffer Zone on April 27, and in the south Buffer Zone on May 6. Surveys began at dusk, about 8:00 p.m., and were completed by 10 p.m. each night.

After the 1-minute adjustment period, the observer listened for boreal chorus frog vocalizations for a 3-minute period. Vocalizations were categorized by intensity indices (0-3).

- 0 = No calling heard
- 1 = Individuals can be counted; calls not overlapping; there is space between calls
- 2 = Calls of individuals are distinguishable, but some calls overlap
- 3 = Full chorus; numerous frogs can be heard; calls are constant, continuous, and overlapping.

Additional information recorded at each survey location included air temperature (°C), water temperature (°C; where feasible), wind speed, cloud cover, precipitation, and noise interference. Data were entered into an electronic database and quality checked prior to data analysis.

2.1.1.5 Project-Specific Special-Concern Species and Wetland Surveys

Special-concern species are a particular class of wildlife and plants that are of special interest at the Site because of their protected status or rarity. These species have been designated on the basis of their rare or imperiled status, as identified by USFWS, the Colorado Division of Wildlife (CDOW), the Colorado Natural Heritage Program (CNHP), and other interested groups. Species placed in this category by the NRCPP are federally listed threatened and endangered species; species proposed by the USFWS for listing; species formerly listed by the USFWS as candidate species; Colorado threatened, endangered, or Species of Special Concern; species from the CNHP lists of rare and imperiled species; and species that are "watch-listed" by other regulatory or natural resource conservation groups. Special-concern species tracked by the NRCPP are listed in Appendix A. The NRCPP monitors the presence, locations, and numbers of these species within project areas to better ensure the Site's compliance with the applicable acts and regulations, and to provide appropriate protection for these species. If species of specific regulatory concern are found to be present in a project area, specific protection or

avoidance plans are developed. When federally listed species will be affected, these surveys provide the basis for informal or formal consultation under the Endangered Species Act.

Project-specific surveys for special-concern species are performed in accordance with the ecology procedures 1-D06-EPR-END.03—threatened and endangered species protection (DOE 1994b), 1-G98-EPR-END.04—migratory bird protection (DOE 1994c), and 1-S73-ECOL-001—wetland protection (DOE 1997). Locations for project-specific surveys are determined by the work plans for construction, assessment, and remediation projects.

2.1.1.6 Fortuitous Observations

Fortuitous observations are chance observations of significant species during performance of other surveys not designed to target these species, or observations made during other activities. Such observations provide important information on species presence, and clues about habitat use and location affinity, particularly for the rarer species at the Site.

2.1.2 Migratory Bird Surveys

Migratory bird species richness and population density data are collected along 20 permanent survey routes (transects) established in all major habitats at the Site. During 1999, two transects were eliminated from the sampling matrix because of newly imposed access restrictions. Thereafter, 18 transects were surveyed. Surveys of these transects are performed by a qualified ecologist who walks the established routes and records data for bird species encountered along the survey belt. Table 2-2 lists survey routes and general habitat types for each transect. Figure 2-4 shows the locations of these routes. Migratory bird surveys collect habitat use and population data for all bird species in different habitats within the BZ. Breeding bird surveys collect the same data as monthly surveys, but are conducted at closely spaced time intervals (weekly) during early summer to provide greater detail on the breeding season. Monthly surveys are performed during the remainder of the year. Migratory bird surveys are performed in accordance with the *EMD Operating Procedures Manual* (DOE 1994a).

2.1.3 Protected Species Surveys (Preble's Meadow Jumping Mouse)

Methods used in Preble's meadow jumping mouse (*Zapus hudsonius preblei*) surveys are summarized here. For a more detailed explanation, refer to Appendix B – 1999 Preble's Meadow Jumping Mouse Study.

2.1.3.1 Trapping Methods

Trapping of Preble's meadow jumping mice and other small mammals follows the procedures outlined for small mammals in the *EMD Operating Procedures Manual Volume V* (DOE 1994a) and conforms to the U.S. Fish and Wildlife Service *Interim Survey Guidelines for Preble's Meadow Jumping Mouse* (USFWS 1997). Different goals were addressed in different parts of the 1999 trapping program.

Small mammal field efforts in 1999 concentrated on studying Preble's meadow jumping mouse (*Zapus hudsonius preblei*) populations in Walnut Creek. The 1999 trapping was performed both in known occurrence areas and in new locations within the drainage. The field effort included two major components: 1) a mark-and-recapture study to estimate the population, and 2) a radio telemetry tracking effort to monitor movements of individual mice within the drainage. These information needs were identified by Site ecologists as important to Site planning and conservation goals for the mouse, as well as providing an important contribution to the efforts of the statewide scientific team that is evaluating the Preble's mouse. Walnut Creek was selected for the 1999 effort in keeping with the cyclical schedule called for by the Site's Integrated Monitoring Plan (IMP; K-H 1998a).

Data for each small mammal captured included species, age, sex, and breeding condition. Each Preble's mouse was measured for key identifying characteristics and examined for identification marks to determine whether it had been captured previously or was a new individual. Each individual Preble's mouse captured was marked with a Passive Integrated Transponder (PIT) tag. During subsequent recapture efforts, all Preble's mice were scanned with the PIT tag reader.

2.1.3.2 Radio Telemetry Methods

The field work for radio telemetry included conducting field trials of equipment, establishing telemetry monitoring stations, trapping mice and affixing collars, and finally, radio tracking individuals in the field. A detailed description of telemetry methods is provided in Appendix B.

First-session (spring 1999) telemetry tracking was conducted mainly at night, and second-session tracking was conducted during the daytime. Animals were located as often as possible, with a preliminary minimum of twice per night (or day). Field personnel avoided approaching or pursuing the collared animal, because observation of normal movements was essential. Readings on individual collar frequencies were taken from at least three monitoring stations, and a compass bearing for each reading was recorded. Bearings were mapped using an ArcView program developed by Ternary Spatial Research of Denver. The intersection of valid bearing lines approximated the transmitter's location. The Universal Transverse Mercator (UTM) coordinates of the estimated points were calculated by the program, and entered into a telemetry database.

2.1.3.3 Habitat Characterization

Habitat was characterized at the trap station (microsite) level only where Preble's mice had not been captured previous to 1999 or where nesting was documented. Where a Preble's mouse was captured in a new area, the habitat was characterized on the basis of 10 trap stations (including Preble's mouse capture points) for each transect. Nesting sites were characterized using the same data collection methods for a single point. Detailed methodology is described in Appendix B.

2.2 Data Analyses

As standard practice, data entry into the Ecological Database is verified and validated to ensure accuracy before data analysis is performed. Corrections are made to entered data as required, and all summary tables used for data analysis are based on the quality-assured data (K-H 1997b).

2.2.1 Multi-Species Census Data Analyses

The Ecological Database was queried to determine the habitat use preferences of each species of interest and the relative abundance of those species. Summary tables for species and/or species groups were then prepared, and the percentages of observations in each habitat were compared to determine habitats of major importance to individual species or species groups, and to determine the relative abundance of those species.

Relative abundance, expressed as observations per minute (o/m), is a means of comparing the abundance of a particular species to itself over time, or comparing relative abundance of one species to another. These comparisons can be made within a single habitat, or a single season, over the entire Site by season or by year. By comparing relative abundance, one can determine how common (or relatively abundant) a species is in specific habitats by season or by year, and how common each recorded species is site wide. A comparison of relative abundance over time can provide specific information on long-term population trends. While relative abundance cannot provide absolute population numbers, the relative abundance of species provides information on trends. For example, when results for a given species are compared year to year (e.g., mule deer relative abundance of 0.201 o/m in Year A compared to 0.119 o/m in Year B, showing a decline in relative abundance), a trend in relative abundance will indicate a trend in the population of that species. Further, if mule deer are recorded at a rate of 0.119 o/m, and turkey vultures are recorded at a rate of 0.0002 o/m, the data show that mule deer are more abundant than turkey vultures. A comparison of observations per minute of a species in a given habitat to observations per minute of that species in another habitat can provide information on the habitat affinities of that species. Each type of information is valuable in determining management strategies either for individual species or for different habitats, depending on the management need.

2.2.2 Significant Species Area Use from Sitewide Surveys Data Analyses

Area use summaries were derived by querying the sitewide significant species survey data in the Ecological Database for grid points from observations of each species. Figure 2-1 shows the grid used to record location data. Summary tables were then prepared to facilitate data analyses for each major species group.

2.2.3 Fish Sampling Data Analyses

Analyses were limited to enumeration of species identified for each stream (i.e., species richness).

2.2.4 Amphibian Monitoring Data Analyses

Data were summarized by frequency within each vocalization index. Distribution was mapped to record sample locations where a species was documented on Site in 1999.

2.2.5 Bird Community and Species Density Analyses

Quality-assured data sets from 1991 and 1993–1999 were analyzed using four community measures: species richness, species diversity, population density, and community similarity. A modified Simpson's Index was used as a measure of diversity (Hair 1980). Bird density was calculated as number of individuals per square kilometer for each species. This calculation used the total transect length by 50 m on each side of the transect (100 m wide). Comparisons of bird community similarity were based on the Jaccard coefficient of similarity (Digby and Kempton 1987).

Calculations were done by habitat, as well as for sitewide observations, for the entire year and for specific seasons. The data sets were standardized to eliminate observations beyond 50 m on either side of the transect line. Observations beyond 50 m are considered less reliable in terms of the number of individuals observed and may not be representative of bird communities in linear habitats (e.g., riparian woodlands). For an explanation of how birds on the wing were handled, refer to Appendix C.

2.2.6 Preble's Meadow Jumping Mouse Data Analyses

Data analyses for the 1999 Preble's mouse monitoring results were divided into four major categories: presence/absence at trapping locations, population estimation, movement patterns based on radio telemetry, and habitat characterization. Methods used for Preble's meadow jumping mouse data analyses are summarized here. For a more detailed explanation, refer to Appendix B – 1999 Preble's Meadow Jumping Mouse Study.

Mark-recapture methodology, using the 1999 Walnut Creek Preble's mouse trapping data, was used to calculate population estimates. A trapping matrix was created and input to "Program Mark™", a software program for use in estimating wildlife populations (Cooch and White 1998). Due to the low number of Preble's mice captured at individual transects, data were pooled. This was done by combining results from all transects in each of the trapping series (i.e., A-, B-, and Lower Walnut series). Within each series, transects are relatively close together and can be considered continuous in most areas.

With the additional capture data provided from 1999 trapping, an estimate for 1998 Rock Creek was also made possible by pooling the data (i.e., combining Walnut and Rock Creek trapping data). This pooled data set was used to calculate population estimates for Rock Creek in 1998 and Walnut Creek in 1999.

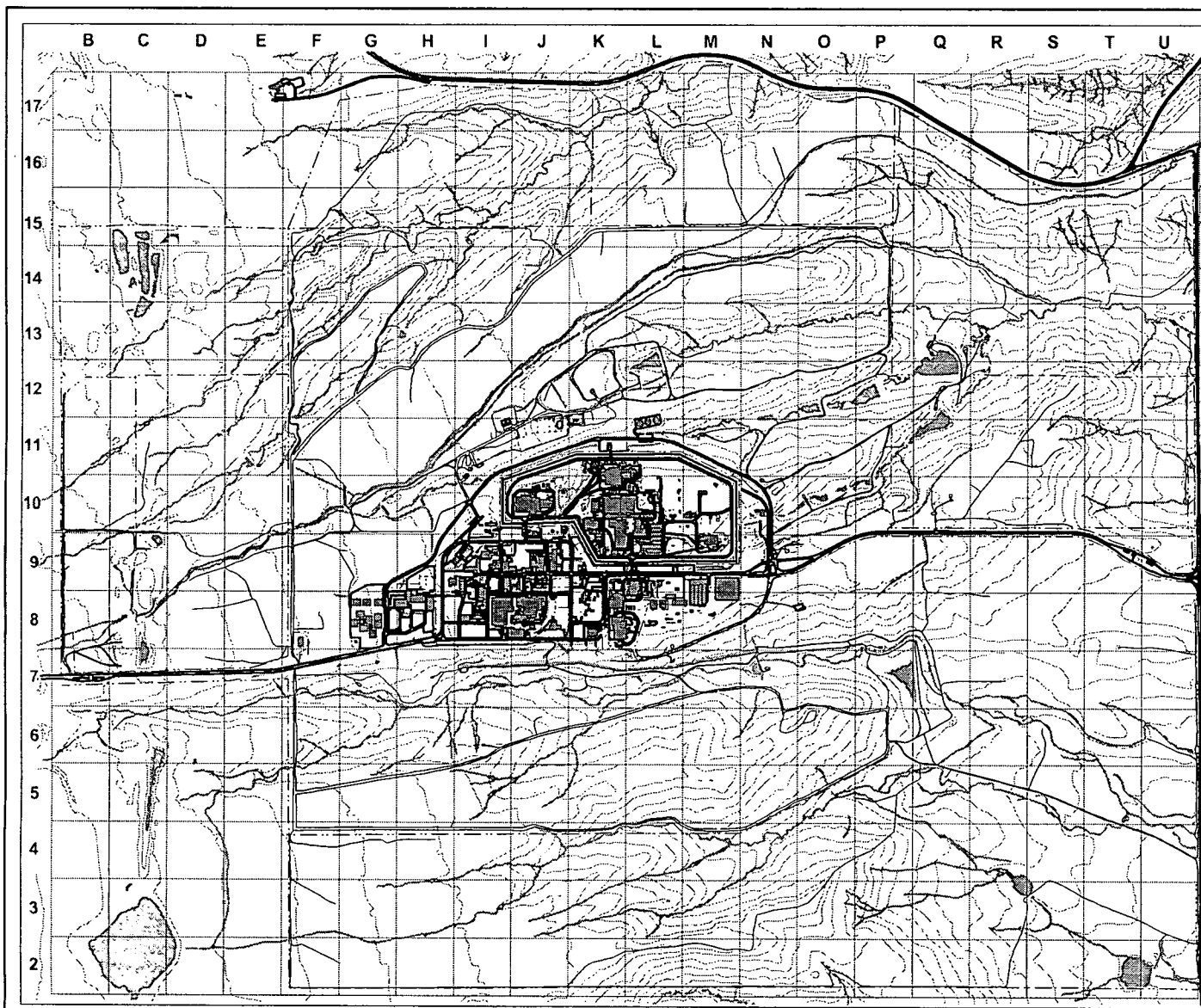
Walnut Creek radio telemetry data were used to calculate the daily (i.e., over a 24-hour observation period) and monthly minimum, maximum, and average movements of individuals, as well as maximum distance from the stream that each collared individual was observed. Because data were in the form of triangulated, calculated points, and not in real-time tracked movement, pathways were estimated.

A data screening process was conducted in which error polygons were created based on points originating from three or more bearings. Points for which error polygons were larger than 0.5 ha (1.2 acres) were excluded from use. The screened telemetry data were subjected to an uncertainty analysis to determine the accuracy of calculated polygons (triangulations from bearings) relative to known visual observation points (located using a global positioning system [GPS]). The uncertainty for each of these bearing groups was calculated as the distance from the visual point to the furthest distant point on the polygon. These calculated points provided estimates of movement distances and directions between observations over the life of the collar transmitter (or while the mouse wore the collar).

Movement data were used to calculate home ranges for each collared mouse. The kernel home range estimator (95% volume contour; Silverman 1986, Seaman and Powell 1996) was used to calculate Preble's mouse home ranges. The software package Home Ranger™ was used to facilitate the calculations.

Because a more refined analysis was conducted on the 1999 Walnut Creek telemetry data, the 1998 Rock Creek telemetry data set was re-analyzed using the same procedures to develop comparable sets of telemetry data from each creek. The revised results for Rock Creek are therefore presented along with the Walnut Creek results in this report. The results include movement endpoints and home ranges for both drainages.

The habitat endpoints were used to characterize Preble's mouse habitat in new capture areas. New-capture sites were compared to the current Site habitat model parameters. Additionally, comparisons of the habitat endpoints were made between years, where appropriate.










Rocky Flats grid.

Figure 2-1.

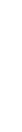
LEGEND

 Rocky Flats grid

Standard Features

-  Dirt roads
-  Paved roads
-  Streams & ditches
-  Fences
-  Contours (25 ft)
-  Buildings & structures
-  Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs, 1/65. Hypsography derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution. The DEM post-processing performed by MK, Winter 1997.



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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

For:

Exponent

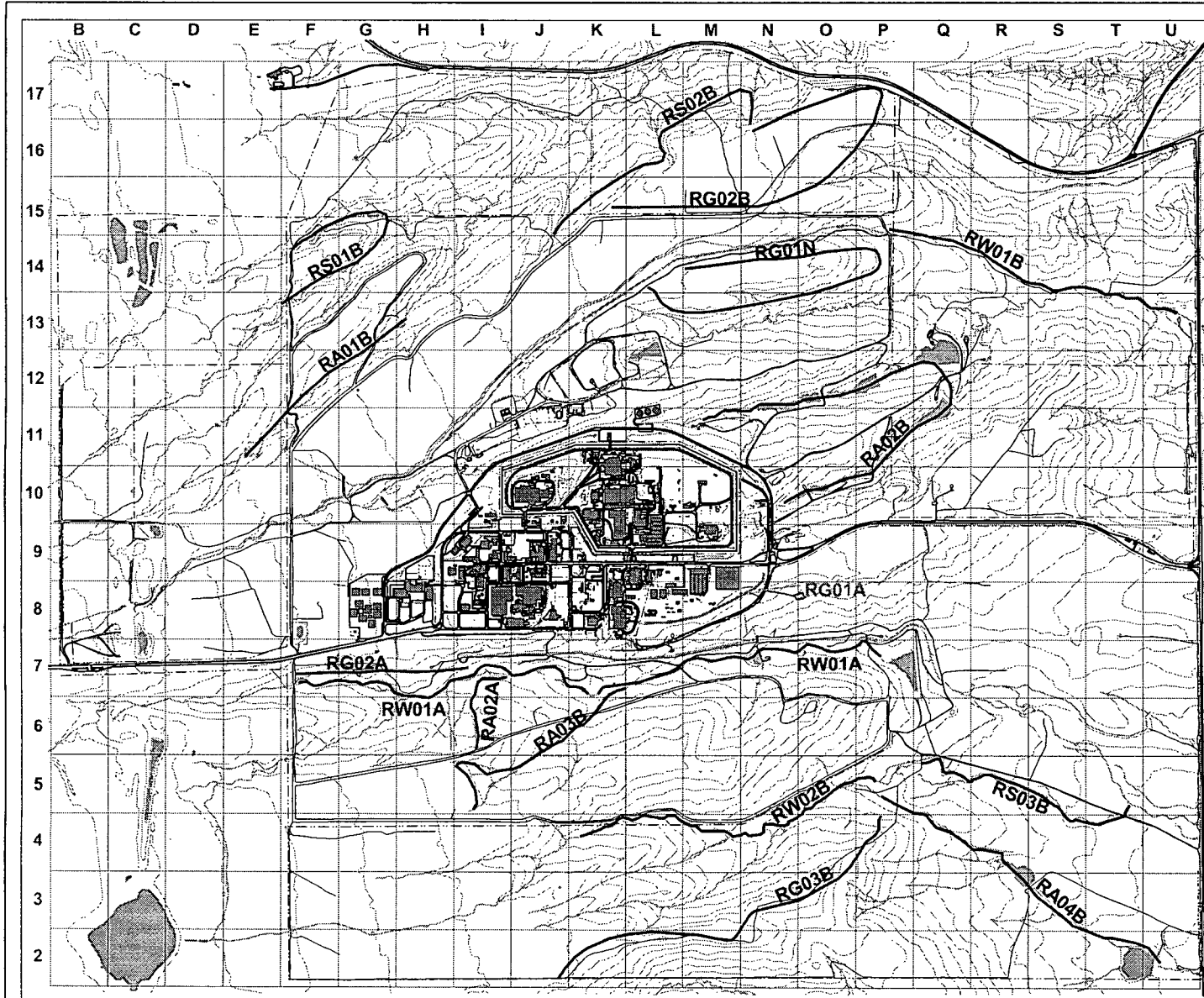


Kaiser-Hill
Company, LLC

MAP ID: 2k-0208

May 8, 2000

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Locations of multi-species census survey transects.

Figure 2-2.

LEGEND

- Active survey transects
- Discontinued survey transects

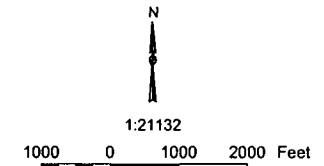
Rocky Flats grid

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

Transect locations and lengths are approximate.

DATA SOURCE:
 Transects & grid provided by Exponent, 2000.
 Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EO&S RSL, Las Vegas.
 Digitized from the orthophotographs, 1/95
 Hypsography derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours.
 The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution. The DEM post-processing performed by MK, Winter 1997.



State Plane Coordinate Projection
 Colorado Central Zone
 Datum: NAD27

U.S. Department of Energy
 Rocky Flats Environmental Technology Site

Prepared by:

For:

Exponent Kaiser-Hill Company, LLC

MAP ID: 2K-0208

May 8, 2000

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1999 Boreal Chorus Frog Monitoring Locations

Figure 2-3

MAP LEGEND

Boreal Chorus Frog
Monitoring Locations

Standard Map Features

-  Buildings
-  Lakes & Ponds
-  Streams & ditches
-  Fences
-  Paved roads
-  Dirt roads
-  Contours (20 ft)

DATA SOURCE:
Boreal Chorus Frog Monitoring Locations
provided by Exponent.
Buildings, fences, hydrography, roads and other
structures from 1994 aerial photo data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotography, 1:50
Hydrography derived from digital elevation model
(DEM) data by Morrison Knudsen (MK) using ESRI Arc Tri
and LATICE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Remote Sensing Lab,
Las Vegas, NV, 1994 Aerial Photo at ~10 meter resolution.
The DEM post-processing performed by MK, Winter 1997.

Note:
These locations are approximate.



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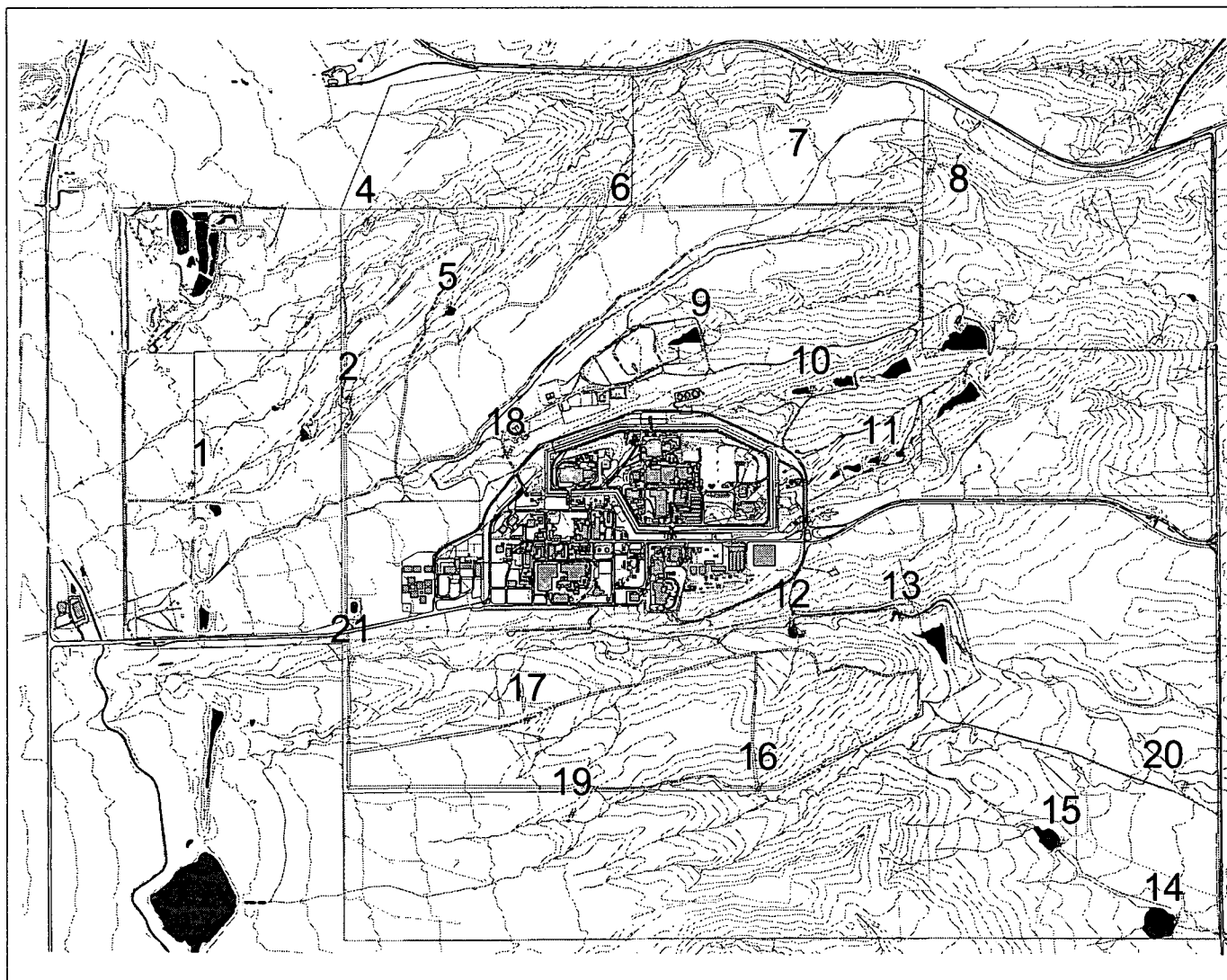
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

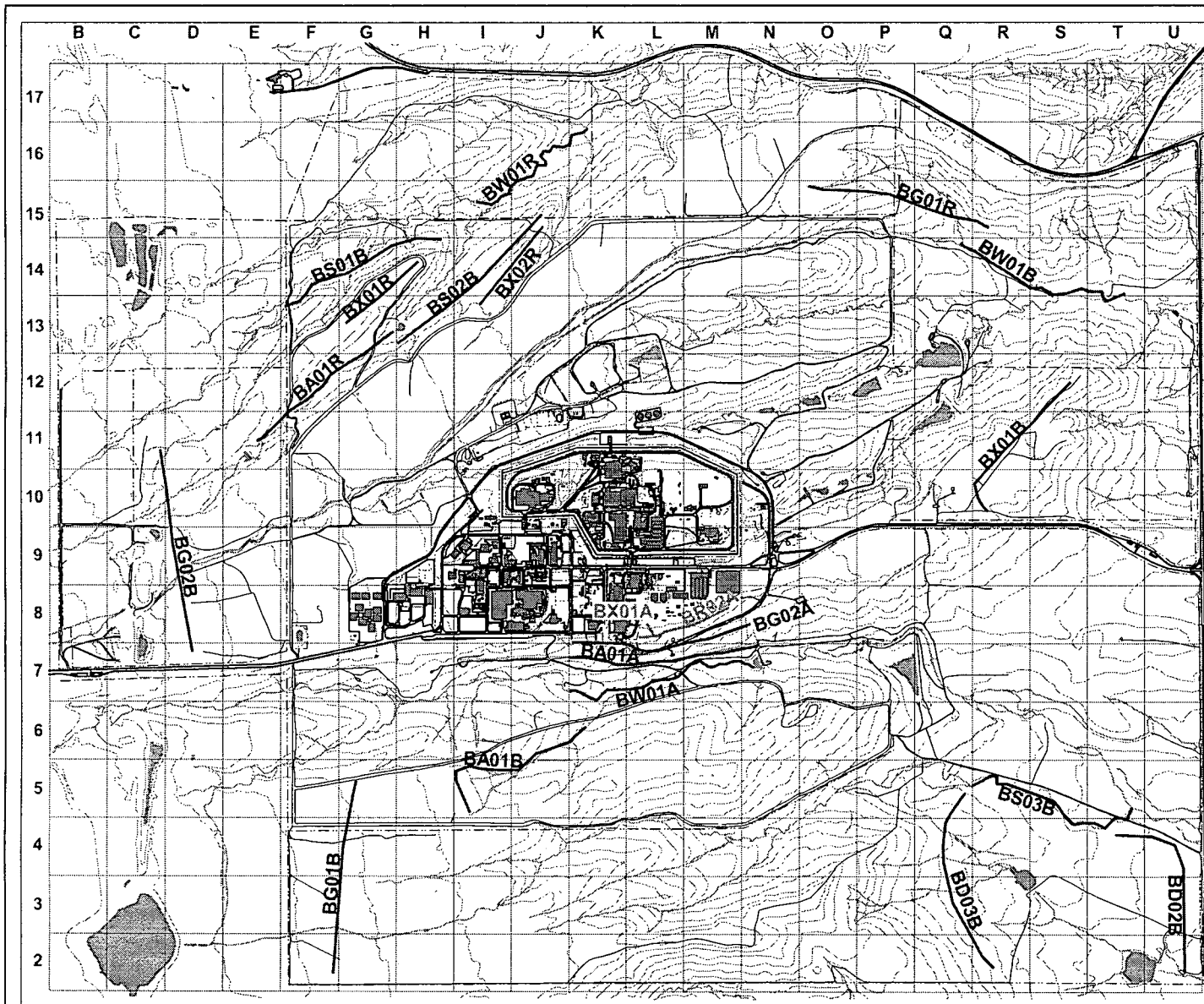
U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:  For: 
Company, ULC

MAP ID: K2-00115

April 26, 2000





Locations of bird survey transects.

Figure 2-4.

LEGEND

- Active bird survey transects
- Discontinued transects

Rocky Flats grid

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

Transect locations and lengths are approximate.

DATA SOURCE:
 Transects & grid provided by Exponent, 2000.
 Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
 Digitized from the orthophotographs, 1985.
 Hypsography derived from digital elevation model (DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution. The DEM post-processing performed by MK, Winter 1997.



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State Plane Coordinate Projection
 Colorado Central Zone
 Datum: NAD27

U.S. Department of Energy
 Rocky Flats Environmental Technology Site

Prepared by:

For:

Exponent

Kaiser-Hill Company, LLC

MAP ID: 2K-0208

May 8, 2000

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Table 2-1. Multispecies census survey transect descriptions

Transect Number	Dominant Habitats Along Transect
RA01B	Wet Meadow (010), Short Marsh (020), Tall Marsh (030), Impoundment (054), Stream Pool (043)
RA02A	Wet Meadow (010), Short Marsh (020), Tall Marsh (030) Tall Marsh (030), Impoundment (054), Stream Pool (043), Mudflats (093), Riparian Woodland (110), Riparian Shrubland-- <i>Salix</i> (212), Mesic Grassland (322)
RA02B	Wet Meadow (010), Short Marsh (020), Tall Marsh (030)
RA03B	Wet Meadow (010), Short Marsh (020), Tall Marsh (030), Impoundment (054), Recalimed Grassland (324)
RG01A	Reclaimed Grassland (324) Now Cancelled Due to New Postings
RG01N	Mesic Mixed Grassland (322)
RG02A	Mesic Mixed Grassland (322)
RG02B	Xeric Mixed Grassland (323), Mesic Mixed Grassland (322)
RG03B	Xeric Mixed Grassland (323), Mesic Mixed Grassland (322)
RS01B	Tall Upland Shrubland (230), Mesic Mixed Grassland (322)
RS02B	Tall Upland Shrubland (230), Mesic Mixed Grassland (322), short Marsh (020)
RS03B	Riparian Woodland (110), Riparian Shrubland-- <i>Amorpha</i> (211), Mesic Grassland (322)
RW01A	Riparian Woodland (110), Riparian Shrubland-- <i>Salix</i> (212), Mesic Grassland (322)
RW01B	Riparian Woodland (110), Riparian Shrubland-- <i>Salix</i> (212), Mesic Grassland (322)
RW02B	Riparian Woodland (110), Riparian Shrubland-- <i>Salix</i> (212), Mesic Grassland (322)
RW03B	Riparian Woodland (110), Riparian Shrubland-- <i>Salix</i> (212), Mesic Grassland (322)

Table 2-2. Bird survey transect descriptions

Transect Number	Transect Length	Dominant Habitats Along Transect
BA01A	1000 m	Tall Marsh (030)
BA01B	1000 m	Wet Meadow (010), Short Marsh (020), Tall Marsh (030), Stream Pool (043)
BA01R	1000 m	Wet Meadow (010), Short Marsh (020), Tall Marsh (030), Stream Pool (043)
BD02B	1000 m	Reclaimed Grassland (324)
BD03B	1000 m	Reclaimed Grassland (324)
BG01B	1000 m	Xeric Grassland (323)
BG01R	1000 m	Mesic Grassland (322)
BG02A	1000 m	Mesic Grassland (322), Reclaimed Grassland (324)
BG02B	1000 m	Xeric Grassland (323), Mesic Grassland (322)
BR02A	500 m	Reclaimed Grassland (324) Now Cancelled Due to New Postings
BS01B	1000 m	Tall Upland Shrubland (230), Mesic Grassland (322)
BS02B	1000 m	Short Marsh (020), Tall Upland Shrubland (230), Mesic Grassland (322)
BS03B	1000 m	<i>Amorpha</i> Riparian Shrubland (211), Riparian Woodland (110)
BW01A	1000 m	Riparian Woodland (110), <i>Salix</i> Riparian Shrubland (212)
BW01R	1000 m	Riparian Woodland (110), <i>Salix</i> Riparian Shrubland (212)
BX01A	100 m	Recovering Xeric Grassland (323) Now Cancelled Due to New Postings
BX01R	500 m	Xeric Grassland (323)
BX02R	500 m	Xeric Grassland (323)
BX01B	1000 m	Xeric Grassland (323)
BW01B	1000 m	Riparian Woodland (110), <i>Salix</i> Riparian Shrubland (212)

Section 3

Results and Discussion

3. Results and Discussion

The following sections present summaries of wildlife monitoring performed under the NRCPP during 1999. Comparisons with previous years are made in the discussions for each species group. Many of the data are summarized by season. For the purpose of this document, seasons are defined as spring (March through May), summer (June through August), fall (September through November), and winter (December through February).

3.1 Significant Species

Significant species monitored during 1999 included big game mammals, large rodents and lagomorphs, carnivores, waterfowl, raptors, fish, herptiles (reptiles and amphibians), and special-concern species. A list of the species included in these groups is provided in Appendix A. The data entry codes for significant species are also described in Appendix A. Discussions in the following sections concentrate on the various significant species groups.

A special effort was also made to monitor the Preble's meadow jumping mouse population in Walnut Creek. Preble's mice were federally listed as a threatened species in May 1998. Radio telemetry was used to monitor Preble's mouse movement in an attempt to better understand how they use their habitat, and to gain additional information on home range. The results of this sampling effort are summarized below in Section 3.1.8.5, and are presented in total in Appendix B.

It should be noted that two types of surveys (as discussed in Section 2) were used in collecting data on the significant wildlife groups discussed below. Sitewide significant species surveys recorded primarily area use (location), but they also recorded instantaneous habitat use for all significant species observed in a short time span over the entire Site. Multi-species census surveys provided data on species richness, relative abundance, and habitat use per unit time of observation along permanently established walking transect lines. Results from both methods are discussed below.

3.1.1 Big Game Mammals

The most common big game species at the Site is the mule deer (*Odocoileus hemionus*). The current population at the Site is estimated at 140 to 150 individuals. White-tailed deer numbers have increased, and it is probable that there are as many as a dozen of that species that use the Site at least part of the year. This estimate is based on a winter deer count, extrapolated to take into account the well-known fact that ungulate herds are routinely underestimated (Wallmo 1981). Site knowledge and previous observations allow the ecologists to extrapolate observed numbers to a population estimate based on

assumed underestimation from some areas of the Site. Relative abundance of mule deer by habitat is discussed in Section 3.1.2.2.

White-tailed deer (*Odocoileus virginianus*) continue to populate the Site in small numbers. White-tailed deer does have been observed increasingly more often with herds of mule deer than in the past. During the baseline characterization (DOE 1992), no white-tailed deer were recorded, but observations have continued to increase in recent years. At present, a group of six to eight individuals is observed periodically in lower Woman Creek and Smart Ditch. From one to several individuals have been observed commingling with mule deer more commonly than in the past, and white-tailed deer were observed in the Rock and Walnut Creek drainages several times in 1999. The species appears to be expanding its range onsite. Most previous observations had been in the lower Woman Creek area. The two deer species do hybridize, and several hybrids have been observed on the Site since 1991. This may become a future management concern for the Site, because such hybridization could affect the long-term viability of the Site's mule deer herd. At present, though, there are now apparently enough white-tailed deer of both sexes that they are breeding to species.

3.1.1.1 Sitewide Significant Species Surveys—Big Game

Winter Deer Count Comparison — A sitewide survey was in late December 1999 for the purpose of obtaining a year-end 1999 population census for big game. The year-end census is always weather dependent, requiring snow-covered ground to provide the best visibility for the most accurate count. This census is typically conducted during the last week of December of the survey year, or as soon as appropriate snow cover is available in January.

The census survey recorded 138 mule deer and nine white-tailed deer. Because the success of winter surveys such as this depends on the weather, often not all deer present at the Site are visible to observers or identifiable by age and sex. Therefore, not all deer are counted or divided into age/sex classes. The winter count has fluctuated since 1994, when the highest count of 164 deer was recorded. In 1994, there were two observers working in tandem, which may have made that count more thorough. In subsequent years, only one observer has conducted the count. It is probable that the two-observer count, because it was made in a shorter time period closer to dawn, more accurately represents all deer present on the Site. From Site ecologists' experience in other locations, and through general conversations with other wildlife biologists over time, it is evident that during census counts, it is never possible to count all big game mammals that are actually present in the survey areas. In past years, when several closely timed counts were made, it was possible to recognize some individuals from one day to the next. In most cases, some individuals observed one day were not observed in a subsequent count, and some new individuals were observed. From these closely spaced surveys, it became evident that as much as 10 percent of the Site population might be missed in any given count. Any population estimate on this species should be viewed as an actual count plus or minus a certain percent of the count. With these assumptions, deer counts on the Site

should be viewed as a means to compare from year to year rather than as an absolute population count. Figure 3-1 shows the winter mule deer count trend from 1994 to 1999.

The age class breakdown continues to indicate a fawn survival rate of approximately one fawn for every two does (1:2). The number of fawns recorded in the year-end census (29) was equal to the mean of the winter fawn counts over the past six years. It should be noted that censuses of mule deer normally yield low counts of fawns (Wallmo 1981). Although opinions vary among mule deer population authorities, a fall-season fawn-to-adult ratio of 30:70 is considered to be optimum for maintaining the herd (Fitzgerald et al. 1994). The year-end census showed 21 percent of the population as young of the year, and some individuals likely went unrecorded. This number cannot be correlated directly to a fall count, because some winter kill occurs among deer herds during late fall and through the winter. A fall-season count in October 1999 recorded only half the winter count, but in similar proportions (23 percent young, 23 percent bucks, 54 percent does).

The number of bucks counted in the year-end census (42) was nearly double the 1998 count (22) and identical to the 1997 number. The ratio of does (67) to bucks became even more favorable for breeding opportunities (1.6:1), showing a good balance for a healthy herd. According to Wallmo (1981), a sex ratio of approximately two adult does per one adult buck indicates a very healthy mule deer population. The variations in mule deer numbers recorded at the Site probably represent normal population fluctuations, but other wildlife professionals, especially Site visitors from the Colorado Division of Wildlife, generally are encouraged and impressed with numbers at the Site. Figure 3-2 shows the age- and sex-class breakdown of the mule deer population from 1994 to 1999.

The number of deer observed during the 1999 year-end count (approximately 0.05 deer/ha, or 14 deer/mi²) was higher than in the past two years (1997, 13/ mi²; 1998, 11/ mi²). This apparent change demonstrates the natural fluctuation that occurs in a population, and underscores the difficulty of obtaining accurate counts of highly mobile species. The relatively large mule deer population at the Site is due to good range condition and the protection afforded them by the prohibition of hunting within Site boundaries. The lack of constant disturbance in the BZ also provides protection from stress, and normally promotes a good fawn survival rate.

Big Game Area Use Summary — In this section, monitoring data from 1999 sitewide significant species surveys are summarized by season (spring, summer, fall, and winter). These surveys were performed once each month from all passable roads in the Buffer Zone, thus providing 12 “snapshot” area use records for the year. Area use data are an important tool used by Site ecologists in helping project planners time disruptive activities to avoid critical periods or essential habitat. Seasonal summaries of mule deer use at the Site reflect the species’ strong year-round preference for some locations and seasonal preferences for other locations. The 1999 area use data summary for mule deer is provided in Table 3-1.

The use patterns reflect two apparent area preference criteria. One preference is for specific seasonal habitat that meets certain survival requirements (e.g., protective cover

for new fawns). A second important area preference is for secluded areas. Some areas preferred by the deer do not provide unique habitat but do offer isolation from disturbance. Figures 3-3 through 3-6 show area use for the four seasons in 1999. Except for a greater year-round concentration in the shrublands and woodlands, there were no remarkable changes in area use from 1998 to 1999.

Mule Deer Spring Area Use: During the spring of 1999, mule deer area use at the Site mirrored longer-term use patterns (Figure 3-3) discussed in previous reports (RMRS 1996; K-H 1997c; K-H 1998c; K-H 1999). Group sizes varied from 2 to 21 individuals, sometimes reflecting weather conditions. Snow-free, south-facing hillsides (where green-up occurs earliest) were most preferred, as were locations providing the best refuge and thermal cover from residual winter storms that are common during March and April. Several areas in the xeric tallgrass prairie community were also used frequently when the weather was not severe.

Mule Deer Summer Area Use: The summer mule deer area use patterns in 1999 also mirrored those found in previous years (Figure 3-4). Area use during the summer was quite dispersed, with high use recorded in the upper Rock Creek shrublands and riparian woodland portions of Woman Creek and Smart Ditch (from multi-species census surveys, 45 percent of the observations were in these two habitats). Observed groups are generally very small. At the start of the summer season (June), fawning occurs, and by the end of the season (August), the young of the year are gaining independence. Areas of heavy concentration are limited in extent, and reflect heavy use by does with fawns or by buck groups. Adequate cover to conceal young, and isolation and security, are requirements for fawning habitat (WGFD 1985). Does with dependent fawns show a strong preference for areas with tall upland shrubland and riparian woodland habitats such as are found in upper Rock Creek and along the bottomland areas of the Woman Creek and Smart Ditch drainages. Rock Creek's tall upland shrubland habitat is ideal for fulfilling these requirements. Bucks are drawn to areas that provide seclusion and shade cover during this season. These areas include Rock Creek shrubland units, and areas in the Smart Ditch drainage basin. Mature bucks are seldom found in the company of does with young during this season (see Table 3-1 for a data summary).

Mule Deer Fall Area Use: Mule deer use patterns during the fall of 1997 were similar in location and extent to the spring use patterns. These, too, mirrored the longer-term use summaries presented in previous annual reports (RMRS 1996; K-H 1998c; K-H 1999). Group sizes ranged from 1 to 17. Certain areas of xeric tallgrass prairie, tall upland shrubland, and riparian habitats were high-use areas (Figure 3-5), reflecting the tendency of the species to concentrate in these areas during the November breeding season (the rut). During the rut, large mixed-sex groups of mule deer are observed frequently in the open grassland areas, often at the same location for several days at a time (see Table 3-1 for a data summary).

Mule Deer Winter Area Use: Winter mule deer area use at the Site during 1999 was fairly dispersed, with preferences shown for upper Rock Creek, the Woman Creek and Smart Ditch bottomlands, and the lower Walnut Creek grasslands (see Figure 3-6). A

pattern of use on south- and southeast-facing mesic grassland hillsides was evident. Some winter use patterns clearly reflect the thermal advantages provided by the preferred areas. Other winter use areas provide better quality, or more available forage, with reduced procurement effort (i.e., a better energy return for the effort). Upper Rock Creek, for example, provides refuge from the frigid northwest winds of the winter months because of its steep topography, narrow valleys, and orientation perpendicular to the prevailing winter winds. With the milder winter weather in 1999, fewer observations were made in these sheltered areas than in some years. South- and southeast-facing slopes provide the greatest incident thermal energy, as well as the best snow-free forage areas. Even as early as late January, many of the early forbs and grasses on these slopes are greening up for spring growth, providing good early-season forage. Winter season observations in 1999 showed the strong preference of mule deer for these areas.

White-Tailed Deer Area Use: White-tailed deer have been observed as single individuals with mule deer groups in widely scattered areas from upper Rock Creek to lower Walnut Creek and lower Woman Creek. White-tailed bucks are observed most consistently with small white-tailed deer groups in lower Woman Creek and lower Smart Ditch, although in 1999, bucks were recorded in several areas (Table 3-1, Figure 3-7). One isolated area in the southeast part of the Site has more commonly harbored small groups of white-tailed deer than in the past.

3.1.1.2 Mule Deer Relative Abundance by Habitat from Multi-Species Census Surveys

Overall annual mule deer relative abundance was 0.12 observations per minute of survey (o/m), compared to 0.12 o/m in 1998 (Table 3-2). Mule deer habitat use varied by season and by habitat (Table 3-3). Mesic mixed grasslands were most heavily used in winter, with a seasonal relative abundance of 0.93 o/m (at 54 percent of use, use was nearly identical to that in 1998. Spring habitat use was divided between woody habitats (45 percent) and other habitats. Riparian woodland/shrubland (33 percent) and tall upland shrubland (24 percent, 0.12 seasonal o/m) were most heavily used in summer. This was similar to habitat use in past years. During fall, relative abundance of mule deer was highest in riparian woodland/shrubland (27 percent), tall upland shrubland (20 percent, 0.14 seasonal o/m), and mesic mixed grassland (17 percent, 0.17 seasonal o/m). This use pattern is similar to past years. The greatest variety of habitats (12) was used during the summer and fall, with seven in spring, and seven in winter. Mule deer relative abundance varied throughout the year, with sitewide relative abundance ranging from 0.25 o/m in winter to 0.07 o/m in summer.

3.1.1.3 White-Tailed Deer Habitat Use from Multi-Species Census Surveys

Habitat use summaries based on multi-species census surveys (Table 3-3) indicate that white-tailed deer use both shrublands and grasslands at the Site. White-tailed deer were in small groups of their own, or in company with groups of mule deer. During 1999, small groups (2–6 individuals) of white-tailed deer continued to use the lower Smart

Ditch/lower Woman Creek/southeast quadrant of the Site. Single does were observed most often with mule deer groups in various parts of the Site. The present total population at the Site may be as many as 10 to 15 animals. The sitewide annual relative abundance of white-tailed deer in 1999 was 0.003 o/m, an increase from 0.002 in 1998.

3.1.2 Lagomorphs and Large Rodents (Sitewide and Multi-Species Surveys)

The most commonly observed lagomorph (rabbit or hare) at the Site during 1999 was the desert cottontail (*Sylvilagus audubonii*), with a sitewide annual relative abundance of 0.003 observations per multi-species survey minute. White-tailed jackrabbits (*Lepus townsendii*) and black-tailed jackrabbits (*Lepus californicus*) have been recorded at the Site, but individuals of both species are seldom observed, and during sitewide significant species surveys and multi-species census surveys, only tracks were observed during 1999. Desert cottontails, as in previous years, were most abundant in disturbed areas, scrap storage areas, trailer yards, storage areas, rip-rap areas, and other areas that afford cover. The 1999 area use data summary, based on sitewide surveys, is provided in Table 3-4. Table 3-5 provides a summary of recorded seasonal habitat use and relative abundance by habitat for these species, based on multi-species census surveys.

Muskrats (*Ondatra zibethicus*) were recorded in impoundments (ponds), most often in association with cattails (*Typha* sp.), with a relative abundance of 0.001 o/m during 1999. Populations of this species are difficult to estimate without a heavy trapping regimen, but observations in 1999 confirmed the continued presence of the species in appropriate habitat. Table 3-4 summarizes recorded area use by this species. Table 3-5 provides a summary of recorded seasonal habitat use and relative abundance by habitat for these species, based on multi-species census surveys.

One porcupine (*Erethizon dorsatum*), now a species protected as a non-game species in the State of Colorado, was observed in riparian woodland. Tracks in the snow indicated that a porcupine was also continuing to use the old Lindsay Ranch house (grid 13E) as a denning site. The porcupine's preferred forage species at the Site are hawthorn (*Crataegus* sp.), chokecherry (*Prunus virginiana*), and ponderosa pine (*Pinus ponderosa*), all of which are most abundant in upper Rock Creek. The presence of this species at the Site is significant, because it verifies that the habitats at the Site are sufficiently diverse to support such increasingly rare species.

Other large rodents that were observed on the Site during 1999 included the eastern fox squirrel (*Sciurus niger*) and a new species for the Site, the bushy-tailed woodrat (*Neotoma cinerea*). These are rare species onsite.

Black-tailed prairie dog (*Cynomys ludovicianus*) populations in the vicinity have continued to rebound, albeit slowly, from the regional die-off in 1994 that was caused by the plague epizootic. Prairie dogs were once established in several colonies at the Site, and have continued to repopulate some historical colony areas. By the end of 1999, prairie dogs were once again evident in three former colonies. Figure 3-8 shows the

locations of the recovering colonies. Because no prairie dog colonies are established on multi-species census survey routes, relative abundance cannot be calculated. Until populations rebound to previous densities, specific prairie dog censuses are unnecessary.

Prairie dog populations at the Site are of interest not only because the USFWS has recently reviewed them for listing as a threatened species, but also because they are considered a "keystone" species in the prairie ecosystem, acting as a prey base for a number of mammalian and avian predators. When their numbers decline, these predatory species also suffer declines in population. In the years since the prairie dog die-off, the numbers of raptors wintering at the Site have been depressed. Because the USFWS found that the petition to list the black-tailed prairie dog had merit, it is now listed as a candidate species, and may be listed in a few years. This may raise future issues with regard to Endangered Species Act compliance, but at present, no remediation is planned where colonies now exist.

3.1.3 Carnivores (Sitewide and Multi-Species Surveys)

The most frequently observed carnivore species at the Site is the coyote (*Canis latrans*), and the next is the raccoon (*Procyon lotor*). Coyotes, which are active both diurnally and nocturnally, were found in all habitats, but were most visible in marshlands and grasslands as they hunted small mammals during the day. Annual sitewide relative abundance for coyotes was 0.009 o/m of multi-species survey time (Table 3-2) (1997, 0.008 o/m; 1998, 0.007 o/m). Relative abundance values ranged from 0.004 o/m in fall to 0.015 o/m in winter. Differences in observation rates may have been influenced by seasonal vegetation density, because high vegetation in spring and summer reduces the species' visibility.

Five coyote dens and several juveniles were observed in 1999, confirming that the Site's coyotes successfully reproduced during the year. Typically, three to four coyote natal dens are located each year at the Site. The estimated number of coyotes on the Site, based on results from sitewide surveys and Site knowledge, remains at approximately 14–16 individuals. The 1999 area use data summary, based on sitewide significant species surveys, is provided in Table 3-6. Table 3-7 provides a seasonal habitat use summary for carnivores in 1999 based on multi-species census survey data. This summary presents primarily coyote relative abundance, because most other species are nocturnal and are seldom observed during daytime surveys.

Raccoons are largely nocturnal, and therefore are documented most frequently from tracks or through small-mammal trapping activities. (Site ecologists often intentionally live-trap raccoons to remove them from the vicinity of small-mammal traplines, because of the raccoons' penchant for robbing bait from the traps.) Raccoons or their sign were observed fortuitously in both the Industrial Area (IA), where they frequented areas with food refuse, and the BZ near riparian channels and pond margins. The limited number of observations precludes making an accurate population estimate.

The presence of several mammalian carnivore species, the top species in the food chain, is an indication of the good ecological condition of the Site. While this program does not attempt to track the numbers of all carnivores at the Site, the indication of steady coyote population over time is a good indication that prey species continue to be abundant. The top carnivores in an ecosystem must have a large, healthy population of prey species upon which to subsist. Reduced numbers of prey species are normally reflected in reduced species richness of carnivores.

3.1.4 Waterfowl—Ducks, Geese, and Shorebirds (Sitewide and Multi-Species Surveys)

As would be expected, the majority of the 34 waterfowl species observed during sitewide significant species surveys and multi-species census surveys were concentrated around the impoundments (ponds). Habitat use reflected the strong preference for open water, pond-margin mudflats, and associated wetlands (Tables 3-8 and 3-9). Area use varied somewhat between the fall/winter and spring/summer seasons. Fall/winter area use was heavily concentrated on the major impoundments at the Site, while spring/summer use was more dispersed. Some observations during the breeding season occurred along creeks, in ditch and creek pools, and in greening-up grasslands. For the first time, a great egret (*Casmerodius albus*) was recorded at the Site in spring 1999. Fourteen species of waterfowl have been documented as breeders or suspected breeders at the Site.

Most waterfowl and shorebirds were observed on the large impoundments at the Site. Diving ducks, such as buffleheads (*Bucephala albeola*), common (*Mergus merganser*) and hooded merganser (*Lophodytes cucullatus*), ring-necked ducks (*Aythya collaris*), redheads (*Aythya americana*), and lesser scaup (*Aythya affinis*), were most commonly observed in the deeper ponds (A-3, A-4, B-5, C-2, and D-2). Species found more generally in shallow waters included blue-winged teal (*Anas discors*), green-winged teal (*Anas clypeata*), mallards (*Anas platyrhynchos*), cinnamon teal (*Anas cyanoptera*), and gadwall (*Anas strepera*). Puddle-ducks, primarily mallards, were also observed in pools, at seeps, and along creeks. Great blue herons (*Ardea herodias*) were observed on impoundment mudflats, and in ditches, short marshland, and wet meadows.

The most abundant year-round waterfowl at the Site during 1999 were mallards, with 384 observations during multi-species census surveys (Table 3-7). The sitewide annual relative abundance of mallards was 0.073 o/m, compared to 0.078 o/m in 1998. The relative abundance of most other waterfowl and shore bird species varied seasonally. Aside from the abundant mallards, the most common spring species were blue-winged teal (0.036 o/m), ring-necked ducks (0.022 o/m in 1999; 0.039 o/m in 1998), American coots (*Fulica americana*) (0.022 o/m in 1999; 0.031 o/m in 1998), and green-winged teal (0.022 o/m in 1999). Blue-winged teal (0.021 o/m), American coots (0.04 o/m in 1999; 0.079 o/m in 1998), and pied-billed grebes (*Podilymbus podiceps*) (0.014 o/m in 1999; 0.029 o/m in 1998) were the most abundant summer species. In fall, the most common species were buffleheads (0.029 o/m in 1999; 0.034 o/m in 1998), ring-necked ducks (0.024 o/m), and American coots (0.024 o/m in 1999; 0.029 o/m in 1998). The fall records were more similar to 1997, when the most common species were also winter-

migrant divers. Unlike 1997 and 1998, when the most abundant species in winter was the redhead, in 1999, the most common waterfowl species in winter were the Canada goose (*Branta canadensis*) and the mallard (0.085 and 0.041 o/m respectively).

Of the wading and shorebird species, killdeer (*Charadrius vociferous*) and common snipe (*Gallinago gallinago*) were the most common species, both at a relative abundance of 0.007 o/m.

Several waterfowl species raised young at the Site during 1999. Brood counts and other observations confirmed nesting by pied-billed grebes, American coots, mallards, and blue-winged teal.

The species richness of waterfowl indicates that waters at the Site are of sufficient quality to attract large numbers of waterfowl, including several species that nest at the Site yearly. Species richness ranged from a high of 23 species in spring to a low of 10 during winter. Twenty-three species were recorded as resident during the breeding season. A number of the waterfowl species stop over during migration because of the diverse aquatic communities in the ponds and, to a lesser degree, the creeks on the Site. Figure 3-9 shows a comparison of species numbers observed since 1993. A significant decline in the species richness or numbers of waterfowl could be an early warning of declining water quality at the Site.

3.1.5 Raptors (Sitewide and Multi-Species Surveys)

Raptors observed at the Site include all those normally associated with the range and habitats of this area of Colorado (Andrews and Richter 1992). One new raptor species, the black vulture (*Coragyps atratus*), was recorded in 1999. This observation was significant in that this species, while expanding its range northward, has not been officially recorded in Colorado. Raptor species using the Site varied between the spring/summer and fall/winter seasons, with great horned owls (*Bubo virginiana*), red-tailed hawks (*Buteo jamaicensis*), and American kestrels (*Falco sparverius*) remaining as year-round residents. Swainson's hawks (*Buteo swainsoni*), turkey vultures (*Cathartes aura*), and ferruginous hawks (*Buteo regalis*) were observed on the Site only in spring/summer. The northern harrier (*Circus cyaneus*), golden eagle (*Aquila chrysaetos*), rough-legged hawk (*Buteo lagopus*), northern harrier, and bald eagle (*Haliaeetus leucocephalus*) were observed mostly in fall/winter. One prairie falcon (*Falco mexicanus*) was recorded during a winter multi-species census survey.

Among most raptors, demonstrated habitat preferences are divided between woody habitats (roosting and nesting areas) and grasslands and wetlands (foraging habitats) (see Tables 3-10 and 3-11). Falcon species were observed most frequently where their preferred prey (largely songbirds) was concentrated, commonly in riparian woodlands and shrublands. Being nocturnal, great horned and long-eared owls (*Asio otus*) normally were recorded in roosting locations during daytime surveys (shrubland, woodland, and abandoned buildings). Buteos (the broad-winged hawks), including roughlegged, red-tailed, and Swainson's hawks, were most often observed either roosting or nesting in

riparian woodland, or soaring over marsh and grasslands where their prey is most abundant. Red-tailed hawks, Swainson's hawks, great horned owls, and American kestrels nested at the Site in 1999.

Recorded area use varied somewhat by season, but raptor observations were generally well dispersed across the Site during all seasons. Except within nesting territories, no particular concentration of activity was noted for any given species. Table 3-10 summarizes seasonal area use by raptors.

Relative abundance of raptors was variable by season (Table 3-11), but the most abundant species year-round was the great horned owl, with a annual relative abundance of 0.0093 o/m. The American kestrel is also a year-round resident, with a 1999 relative abundance of 0.0074 o/m. The red-tailed hawk's spring relative abundance was 0.005 o/m, and its sitewide annual relative abundance was 0.0092 o/m. Swainson's hawks high relative abundance (0.0015 o/m) was probably because a nest site was located within an established multi-species survey transect.

The continued presence of nesting raptors at the Site in 1999 indicates that habitat quality and protection from disturbances have contributed to making the Site a desirable location for raptors to reproduce. The normal seasonal species assemblages of raptors were observed at the Site, indicating that the habitat still provides the essential seasonal requirements for these species. Numbers and species richness remained similar to previous years, indicating that the Site probably supports the optimum population of these territorial species. Figure 3-10 shows a comparison of species numbers observed since 1993.

3.1.6 Fish Sampling

Fish were collected in each pond across the Site during 1999. The ongoing fish sampling effort is designed to determine whether previously recorded fish species (DOE 1992) are still present at the Site, and to document any new species that might be present. Except for introduced species (e.g., largemouth bass), fish species that have been recorded at the Site are small stream fishes that are adapted to narrow, intermittent stream and pool systems. Sampling was timed to avoid spring floods and allow sampling under more normal water levels.

The Site is dissected by four major stream drainages—Smart Ditch, Woman Creek, Walnut Creek, and Rock Creek—all flowing generally west to east across the property. These small, ephemeral to intermittent headwater streams are interrupted in places by impoundments that were built as either stock ponds or retention ponds. These ponds provide different habitats than those found in the Site's small streams. In keeping with the alternating sampling schedule established for fish monitoring, ponds were sampled in 1999.

Minnow traps were set out near pond inlets, at points along the shorelines, and in the deeper water near dams. Trapping was done for two consecutive days at each sample point (see Figure 3-11). The numbers of fish captured varied, with large numbers of fathead minnows (*Pimephales promelas*) captured in several ponds (Table 3-12). Fathead minnows were captured in all ponds sampled, which was expected because they are present in all Site streams. Additionally, creek chubs (*Semotilus atromaculatus*) were captured in Pond C-1; they have been documented previously in segments of Woman Creek where there is adequate water. A new species for the Site was also recorded in Pond C-1 when a number of smallmouth bass (*Micropterus dolomieu*) were captured. Although none was captured in minnow traps, largemouth bass (*Micropterus salmoides*) were observed in Lindsay Pond at all times that traps were visited. It is probably because of the large bass population in that pond that nothing except one tadpole was captured during the trapping effort in that pond.

3.1.7 Herptiles (Reptiles and Amphibians)

3.1.7.1 Amphibian Vocalization Monitoring

As a taxonomic group, the frogs and toads at Rocky Flats Environmental Technology Site (Site) are recorded only occasionally during normal wildlife monitoring. Most observations are in the form of fortuitous observations. Although this provides an annual presence/absence record for these species at the Site, the lack of a repeatable methodology prohibits tracking information on population abundance or the distribution of these species on Site. Population trend and distribution information on these species can provide additional insight and act as an additional tool for detecting change in the health of the Site aquatic ecosystems, which currently receive limited ecological monitoring. Because their semi-aquatic nature makes them sensitive to impacts in the aquatic ecosystems, monitoring these species can provide additional insight into ecosystem health and stress, and can help to detect potential contamination (Blaustein 1995).

In 1998, a feasibility study was conducted to evaluate survey methodologies that use vocalizations for determining population trends of frog and toad species (Mossman et al. 1998; Mossman and Hine 1984, 1985; NBS 1997). Three species of frogs were recorded in 1998 using the vocalization technique: the boreal chorus frog (*Pseudacris triseriatus*), the northern leopard frog (*Rana pipiens*), and the bullfrog (*Rana catesbiana*; K-H 1999). Results indicated that the boreal chorus frog was the best candidate for vocalization monitoring, and could also serve as an indicator species for tracking general amphibian population abundance on the Site. During 1999, the survey methodology was modified, and only the boreal chorus frog population on the Site was surveyed. The investigation was designed to describe the distribution of boreal chorus frogs on the Site, determine whether the distribution is similar to that found in 1998, and compare the vocalization indices in 1999 with those from 1998.

Boreal chorus frogs were recorded at 15 of the 20 sampling locations. Sixty percent of the locations sampled had full choruses of frogs calling (vocalization index 3;

Figure 3-12) and 15 percent had multiple individuals calling, with some calls overlapping (vocalization index 2; Figure 3-13). Of the locations sampled, 75 percent had boreal chorus frogs present, and 92 percent of the populated locations had a full chorus of frogs calling. This was compared to 1998, when boreal chorus frogs were present at 82 percent of the sampled locations, with 64 percent of the populated locations having a full chorus of frogs calling (K-H 1999). Comparison of 1999 data to 1998 results, using only the sample locations that were sampled during both years, revealed similarities (Figure 3-13). In 1999, boreal chorus frogs were found at the same locations—except one—where they had been documented in 1998. At the exception location, only a few individuals had been calling in 1998, so hearing none in 1999 is not a cause for concern. At every other location, the vocalization indices were higher in 1999 than in 1998, indicating the continued presence and high abundance of boreal chorus frogs at the Site.

Comparing the 1998 and 1999 vocalization index frequency data, the most noticeable difference in 1999 was that no calls were recorded in category one, but this decrease appears to have been made up by the increase in category three. Direct comparison of data is made somewhat difficult because of the change in sampling locations; however, it is generally accurate to state that although boreal chorus frogs were present at slightly fewer sampling locations in 1999, their abundance at those locations was higher in 1999 than in 1998. It may be that pool size and water availability play a part in the distribution of mating concentrations from year to year. Boreal chorus frogs are more often found in meltwater and runoff pools than in streams or larger ponds.

The lower abundance of boreal chorus frogs in the south Buffer Zone is most likely due to the lower water availability there. There are fewer hillside seeps and ephemeral streams, and fewer depressions for water to collect, resulting in less suitable habitat. Similar low abundance of boreal chorus frogs was documented in 1998 in the south Buffer Zone. Boreal chorus frogs were found at only 50 percent of the sampled locations in the south Buffer Zone in 1998 (K-H 1999) compared to approximately 44 percent in 1999 (Figure 3-14). It is unlikely that sky conditions affected the 1999 results (i.e. it was clear during south Buffer Zone surveys and cloudy during those in the north Buffer Zone), because in 1998, similar mostly clear skies were present during both the north and south Buffer Zone sampling.

The distribution of boreal chorus frogs heard during the surveys on the Site in 1999 is shown in Figure 3-14. Boreal chorus frogs occurred with the greatest frequency and abundance (based on calling indices) in the north Buffer Zone. They were heard at all Rock Creek drainage sampling locations, but at less than 50 percent of the sample locations in the south Buffer Zone.

3.1.7.2 General Herptile Observations from Other Monitoring

Herptile species observed during 1999 included the boreal chorus frog, northern leopard frog, bullfrog, western painted turtle (*Chrysemys picta*), eastern short-horned lizard (*Phrynosoma douglassii brevirostra*), and the prairie rattlesnake (*Crotalus viridis*). One

new species for the Site was the snapping turtle (*Chelydra serpentina*), recorded in Pond A-3.

Observations of these species were sporadic and widely dispersed. Observations made during sitewide significant species surveys are summarized in Table 3-13, and observations from multi-species census surveys are summarized in Table 3-14. Habitat preference of herptiles varied by species. Table 3-14 presents habitat use as recorded during multi-species census surveys.

Boreal chorus frogs were abundant during the spring breeding season. Relative abundance calculated from observations during spring was 0.111 o/m. Western painted turtles were most frequently observed in spring and summer (0.019 o/m and 0.028 o/m respectively). Bullfrogs were most common in fall (0.002 o/m).

The presence of several sensitive reptile and amphibian species is an indicator of ecosystem health within the various habitats at the Site. Aside from call-count vocalization intensity categorizations for stationary breeding frogs and toads, obtaining a census of herptile species is difficult; therefore, estimates of populations cannot be made from the data presented here.

3.1.8 Special-Concern Species

Special-concern species are defined in Section 2.1.1.3. While the majority of the special-concern species that use or have potential to use the Site are animals, a few plant species also are included. It should be noted that these species are designated as special concern because of their rarity. Observations of rare species are inherently sporadic and infrequent; consequently, many of these species may not be observed at the Site every year. Lack of observations of special-concern species at the Site in any given year is not considered cause for alarm; however, no observations of a species for several years in a row would trigger a more intensive search, particularly if no regional decline in the species has been reported.

Aside from the Preble's meadow jumping mouse, which is resident at the Site, two threatened or endangered species use the Site seasonally. There are also several federal special-concern species and Colorado Species of Special Concern. Table 3-15 presents the Site's 1999 search list for special-concern species.

3.1.8.1 Threatened and Endangered Species

The Preble's meadow jumping mouse was the only federally listed threatened species observed at the Site in 1999. Preble's mouse monitoring is reported below in Section 3.1.8.5.

Threatened and endangered species are of concern at the Site because of their protected status under the ESA. Site activities must be planned such that no take (harassment or

harm) of these species occurs during the time they are present within Site boundaries. DOE must enter Section 7 consultation under the Endangered Species Act when Site actions may affect these species.

3.1.8.2 Federal Special-Concern Species

Federal special-concern species observed during 1999 included the eastern short horned lizard, the loggerhead shrike (*Lanius ludovicianus*), and the black-tailed prairie dog.

3.1.8.3 Colorado Species of Special Concern

Colorado Species of Special Concern using the Site during 1999 included the northern leopard frog (*Rana pipiens*) and the American white pelican (*Pelecanus erythrorhynchos*).

3.1.8.4 Watch-Listed Species

Watch-listed species observed at the Site during 1999 included raptors such as the Swainson's hawk (*Buteo swainsoni*), the northern harrier (*Circus cyaneus*), the prairie falcon (*Falco mexicanus*), and the golden eagle (*Aquila chrysaetos*). Water birds included the bufflehead (*Bucephala albeola*) and the sora (*Porzana carolina*). Songbirds on the list of watch-listed species included the marsh wren (*Cistothorus palustris*) and the grasshopper sparrow (*Ammodramus savannarum*).

3.1.8.5 Preble's Meadow Jumping Mouse Monitoring

Small-mammal field efforts in 1999 at the Rocky Flats Environmental Technology Site (Site) concentrated on studying populations of the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Walnut Creek. Walnut Creek was selected for the 1999 effort in keeping with the staggered schedule called for by the Site's Integrated Monitoring Plan (IMP; K-H 1998a). Live trapping was performed both in known occurrence areas and in new locations within the drainage. The effort consisted of two major components: a mark-recapture study to estimate the population, and a radio telemetry tracking effort to monitor movements of individual mice within the drainage. The full report on this trapping and monitoring effort is presented in Appendix B of this document. A summary of the findings is presented in this section.

During 1998, Site ecologists conducted a similar monitoring effort in Rock Creek (K-H 1999). In that study, nine individuals traveled an average of 142 m (464 ft) over a 24-hour interval and used 715 m (2,346 ft), on average, of stream segment during one month in the summer (K-H 1999). Results of a previous trapping effort in Woman Creek indicated that Preble's mice travel distances of 1,205 to 1,610 m (0.75 to 1 mile) within that creek drainage (K-H 1997c). Observations from these two studies suggested

extensive use of stream reaches where habitat is contiguous. Woman and Rock Creeks have relatively long stretches of continuous habitat. Walnut Creek, however, has a much less contiguous distribution of habitat, due to interruption by the water impoundments, and also has a highly regulated water flow regime. Walnut Creek is the main carrier of effluent from the Industrial Area's domestic water treatment system and is therefore subject to intensive regulation and water flow management. Site ecologists were generally interested in discovering whether the interrupted habitat influences the travel distances and population distributions as compared to the other drainages.

The 1999 monitoring program was designed to determine nightly and monthly movement patterns of Preble's mice, monitor selected known population centers, and study the demographics of the Walnut Creek population. The field effort addressed questions about movement and dispersal, occurrence and population estimates, and habitat characteristics in Walnut Creek.

The 1999 Preble's mouse trapping data were used to calculate population estimates by mark-recapture methods. A trapping matrix was created and input into "Program Mark™", a software program for use in estimating wildlife populations (Cooch and White 1998). Due to the low number of Preble's mice captured at individual transects, analysts used data pooling to obtain more robust datasets. This was done by combining results from all transects in each of the trapping series (i.e., A-, B-, and Lower Walnut series). Within each series, transects are relatively close together and can be considered contiguous in most areas.

With the additional capture data provided from 1999 trapping, it was possible to use data pooling for the two years to provide a new 1998 estimate for Rock Creek. This pooled data set was also used to re-calculate the initial 1999 Walnut Creek estimates.

Radio telemetry data were used to calculate the daily (i.e., over a 24-hour observation period) and monthly minimum, maximum, and average movements of individuals, as well as the maximum distance from the stream that each collared individual was observed. Because data were in the form of triangulated, calculated points, and not in real-time tracked movement, pathways were estimated.

Telemetry data were also used to calculate home ranges for each collared mouse. The kernel home range estimator (95% volume contour; Silverman 1986; Seaman and Powell 1996) was used to calculate Preble's mouse home ranges. The software package "Home Ranger™" was used to facilitate the home range calculations.

The habitat endpoints for Preble's mouse habitat characterization (Appendix B) were used to describe areas where new captures were made. New sites in Walnut Creek were compared to the current Site habitat model parameters based on information from Rock and Woman Creeks. Additionally, comparisons of the habitat endpoints were made between years, where appropriate.

Small Mammal Trapping Results — During 8,750 trap nights (Appendix B) in Walnut Creek, 4,219 small mammals were captured. During the first session, deer mice represented the largest percentage (50.1 percent) of small mammals captured, and second-sessions captures were dominated by meadow voles (59.9 percent). Over both sessions, a total of eight small mammal species were captured.

The typical rise in the number of deer mice and harvest mice with the addition of young-of-the-year was not observed in 1999 (Appendix B). The number of deer mice observed during the second session was actually lower than during the first. Harvest mice represented a very low portion of total mammals captured. This is a continuing trend for harvest mice, as seen in Rock Creek in 1998. In 1995, trapping in both Rock and Walnut Creeks yielded 135 captures of harvest mice (K-H 1996). Woman Creek was trapped in 1997, and 75 captures of harvest mice were reported. Other researchers (Armstrong et al. 1996; Meaney et al. 1996, 1997) also reported low numbers of harvest mice while conducting Preble's mouse studies. There is insufficient information to draw any conclusions about the low numbers of harvest mice, but this apparent trend may bear watching if it continues. It may be just a result of how harvest mice select seasonal habitat, or some other variable that reduces the number captured during Preble's mouse trapping activities.

Preble's Mice — Twenty-nine captures (including recaptures) were made over both trapping sessions (Appendix B). The relative abundance of Preble's mice was 0.33 per 100 trap nights. Twelve individuals (seven adult males, four adult females, and one juvenile male) were captured during the first session. Eight individuals (five adult males, three adult females) were captured during the second session. Only one female mouse was captured during both sessions. Of the 19 individuals captured during both sessions, seven of them were recaptured at least once, and as many as four times.

Captures of Preble's mice in 1999 were comparable to those in 1995 (K-H 1996), with the exception that the 1995 trapping duration was much longer than the 1999 sessions. For comparison, 1995 Walnut Creek trapping yielded 62 captures of 21 individuals—a relative abundance of Preble's mice of 0.68 per 100 trap nights. Most of these captures occurred from August to October 1995. In 1995, 11 of the 21 individuals were captured more than once, with two individuals being recaptured nine times each (K-H 1996).

Capture Probability: A capture probability was estimated before modeling all other population parameters. The capture probability, calculated based on statistics, is the probability that a given mouse may be captured or recaptured. All results were based on a weighted average of the estimates from each of these models. Capture and recapture probability estimates (Est.) and standard errors (SE) are as follows:

Walnut and Rock Creek capture probabilities

	Walnut Creek				Rock Creek			
	Session 1		Session 2		Session 1		Session 2	
	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Initial capture probability, p	0.304	0.059	0.304	0.059	0.296	0.069	0.296	0.069
Recapture probability, c	0.105	0.034	0.105	0.034	0.098	0.029	0.098	0.029

Survival Rates (Residency): Determining survival rates is essential to estimating populations at various points in time (i.e., over two trapping sessions or over a winter season). After much consideration, a better explanation is provided by stating that this parameter is really a measure of site residency, because it represents the proportion of animals that survived *and* remained on the study site so as to be available for trapping. Therefore, this term should be referred to as apparent residency. Although data were insufficient to estimate residency rates for each transect separately, residency rates were computed for the Walnut and Rock Creek data. The overall (pooled) residency rate is 9.2 percent for the period between sessions. This corresponds to a 45.2 percent average residency per month for the four sites at Walnut Creek and the two sites at Rock Creek combined.

Population Estimates: Trapping results from the 12 Walnut Creek transects and the 10 Rock Creek transects (Appendix B), each run over two sessions, were used to model capture probability, survival rates, and population estimates for Preble's mice at the Site. They were pooled because earlier attempts to estimate Rock Creek populations were not possible without recaptures. Transect data were pooled to form the following population units:

- Walnut Creek
 - A-series upper (three transects)
 - A-series lower (two transects)
 - Lower Walnut (four transects)
 - B-series (three transects).
- Rock Creek
 - Upper Series (six transects)
 - Lower Series (four transects).

Along with residency-rate modeling, population estimates were determined by modeling. In the following table, N = estimated number of individuals per trapping site, and se(N) = standard error of N.

Walnut and Rock Creek population estimates, 1998 and 1999

Site	Session 1		Session 2	
	N	se(N)	N	se(N)
Walnut A, upper	8.3	0.6	4.1	0.3
Walnut A, lower	0.0	0.0	1.0	0.0
Walnut B	2.0	0.1	1.0	0.0
Walnut, lower	2.0	0.1	2.0	0.1
Rock Creek, upper	5.4	1.0	0.0	0.0
Rock Creek, lower	3.2	0.6	4.3	0.8

When all population estimates for the Walnut Creek drainage are combined with the length of available habitat, a total calculated population of 41 (± 3) mice is estimated for Walnut Creek in 1999. This compares to a total of 71 (± 14) mice in Rock Creek one year earlier, illustrating that Rock Creek, with its greater length of available habitat, can likely support a larger population than Walnut Creek can. However, caution should be used in interpreting these numbers, given the fact that Rock Creek was trapped a year earlier and populations may fluctuate from year to year. These population numbers should be used with caution, because they are estimates—not actual numbers.

Density Estimates: Population estimates were converted to density estimates (i.e., the number of mice found per kilometer of stream reach, regardless of the habitat width) to provide a basis for estimating actual populations on the Site.

Walnut Creek had the highest density of mice in the habitat patch above the A-1 pond. This density surpassed those estimated for the B-series, Lower Walnut, and 1998 Rock Creek estimates. This area above the A-1 Pond remains important in terms of Preble's mouse conservation and likely indicates an area of very high habitat quality.

Given these numbers and the length of the streams, it was then possible to estimate populations for Rock Creek and Walnut Creek. Prior random selection of trapping transects from all available habitat allowed estimation of the entire population of each drainage.

Density conversion for Walnut and Rock Creeks, 1998 and 1999

Site	L_o	L_a	p^1	se(p)	Session 1		Session 2	
					D (No./km)	se(D)	D (No./km)	se(D)
Walnut A, upper	450	553	0.814	0.027	14.9	1.08	7.4	0.53
Walnut A, lower	300	466	0.644	0.025	0.0	0.0	2.1	0.04
Walnut B	450	696	0.647	0.017	2.9	0.20	1.4	0.02
Walnut, lower	600	776	0.773	0.018	2.6	0.18	2.6	0.18
Rock Creek, upper	900	1297	0.694	0.010	4.2	0.78	0.0	0.00
Rock Creek, lower	600	932	0.644	0.013	3.5	0.65	4.7	0.87

¹ Proportion of animals trapped that are resident on the grid versus drawn from adjacent areas.

L_o = the original length. L_a = adjusted length; area from which mice were assumed to have been attracted from adjacent areas to bait.

Preble's mouse population estimates for Rock and Walnut Creeks, 1998 & 1999

Creek	Series	Estimate		Density (# / km)		Stream Length	Population
		Session 1	Session 2	Session 1	Session 2		
Rock	Upper	5.4 (± 1.0)	0.0	4.2 (± 0.8)	0.0	8.5	36 (± 7)
	Lower	3.2 (± 0.6)	4.3 (± 0.8)	3.5 (± 0.7)	4.7 (± 0.9)	4.3	35 (± 7)
Walnut	A-upper	8.3 (± 0.6)	4.1 (± 0.3)	14.9 (± 1)	7.4 (± 0.5)	0.9	20 (± 1)
	A-lower	0.0	1.0 (± 0.0)	0.0	2.1 (± 0.0)	0.7	2 (± 0)
	B-series	2.0 (± 0.1)	1.0 (± 0.0)	2.9 (± 0.2)	1.4 (± 0.0)	1.4	6 (± 0)
	Lower	2.0 (± 0.1)	2.0 (± 0.1)	2.6 (± 0.2)	2.6 (± 0.2)	2.5	13 (± 1)
Total						27.2 km	112 (± 17)

This analysis indicates that there are 112 (± 17) Preble's mice in Rock and Walnut Creeks, combining estimates for both years.

Telemetry Results: All 19 of the Preble's mice captured during the 1999 trapping were fitted with radio collars. Some mice slipped their collars, but most individuals were radio-tracked for the duration of the battery life of the transmitter, up to 30–35 days. Of the individuals tracked for the duration of each session, 12 were radio-tracked during the first telemetry session (22 May to 16 July), and 8 (5 males and 3 females) were tracked during the second session (25 August to 7 October). One female was captured, collared, and tracked during both sessions.

Data were screened for errors, then the remaining points were combined with capture locations and visual observations—for a total of 263 points—and used in calculating Walnut Creek movement information. In the same manner, the original Rock Creek

telemetry data were screened and reanalyzed. A total of 181 points were used in re-calculating the Rock Creek movement endpoints.

Distribution in Walnut Creek: The 12 individuals tracked during the first session in Walnut Creek were mostly in the A-series (see Appendix B for greater detail). Eight individuals were tracked in the A-series, two in Lower Walnut Creek, and two in the B-series. The A-series individuals traveled widely within the habitat upstream of the A-1 pond. This habitat unit appeared to encompass most of the home ranges of all the A series individuals during the telemetry period. During the telemetry session, they did not use the upland grasslands to any great extent, but seemed to be restricted to the riparian and upland shrub vegetation types found upstream of the A-1 pond. Riparian habitat was the main travel pathway used when individuals did move. Overland travel out of the riparian zone was not observed in Walnut Creek. The wide-ranging patterns of the Rock Creek mice in 1998 (K-H 1999) were not seen in the A-series mice.

The first-session mice in the B-series and Lower Walnut Creek demonstrated the same restricted movements, with the exception of one adult female in the B-series. This individual traveled from upstream of the B-1 pond to the inlet of the B-4 pond over a 24-hour period. This is a straight-line distance of approximately 350 m. This individual was also located below the B-4 dam briefly one night. The most likely travel route was across a one-lane gravel road approximately 5 m wide.

During the second session, A-series mice demonstrated the same restricted distribution as observed during the first session. However, a new individual was captured at the A-3 pond inlet. This was the second time a mouse had been captured at this location. Second-session individuals of the B-series and Lower Walnut Creek also demonstrated the same limited distribution, with one exception. A female was captured in a transect below the Walnut Creek and McKay Ditch confluence, and subsequently was tracked downstream a total of 290 m to a suspected hibernation site.

No mice were observed, through radio telemetry, to move from one section of Walnut Creek to the other (e.g., from the A-series to the lower section, or from the B-series to the lower section). In fact, the overall movements of mice in Walnut Creek in terms of short-duration movement (i.e., 24-hour period), 20+ day movement, and use of adjacent habitat (i.e., distance observed perpendicular from the stream) were notably more restricted than those seen in Rock Creek in 1998 (Appendix B). In the relatively contiguous habitat found in Rock Creek, mice were documented to move greater distances over the short term, use a larger section of stream reach, and use areas a great distance away from the main channels of the creek (up to 233 m; Appendix B). These observations may indicate that the discontinuity of habitat found in Walnut Creek somewhat restricts movements of Preble's mice. Or perhaps some of the ponds and associated dam faces are large enough to be a barrier to movement (e.g., the A-4 and B-5 ponds).

During the 1999 Walnut Creek monitoring, adjacent upland areas in both the A- and B series tributaries were disturbed by remediation projects, although the disturbances did not encroach into the riparian habitat. Preble's mice had relatively restricted movement

patterns in the A- and B-series tributaries, in that their movements were less on average than movements observed in Rock Creek in 1998. Although this movement restriction might have been interpreted to be a result of the construction, that is not believed to be the case, because monitoring (i.e., telemetry observations) was conducted mostly at night during the first session, and the construction was under way during the day. It does not follow that construction activities conducted only during the day would restrict mouse activity at night. Additionally, if the construction was affecting the mice, one would have expected to see movement downstream over the course of the telemetry period (20+ days), but this also was not the case. In fact, mice were shown to move both nearer and farther away relative to the construction activities, and there is no indication of a correlation between the mouse's movements and construction activities. Instead, it appears that by protecting the suitable habitat of the Preble's mice in Walnut Creek (Figure 5), and not allowing the construction activities to encroach or destroy habitat, the construction projects had little effect on the populations and left them intact and viable.

Travel Distances in Walnut Creek: Using telemetry data points, distances traveled were computed for average and maximum movement over a 24-hour observation period, and average and maximum length of stream reach used over the telemetry session (20+ days). The average distance a mouse traveled between 24-hour observations in the first session was 57 m (187 ft; n = 98 observations). The maximum distance traveled between 24-hour observations was 386 m (1,266 ft). The average distance a mouse traveled between 24-hour observations in the second session was 55 m (180 ft; n = 59 observations). The maximum distance traveled between 24-hour observations was 485 m (1,591 ft).

The linear stream reach used over the telemetry session (20+ days) is intended to provide an estimated length of stream used by individual mice in summer. The average distance used was 320 m (1,050 ft, 0.20 miles; n = 4) of stream during the first session and 282 m (925 ft, 0.17 miles; n = 4) during the second session. The maximum distance observed over both sessions was 597 m (1,962 ft, 0.37 miles) of stream.

The maximum perpendicular distance away from the Walnut Creek stream channel at which an individual was observed was 68 m (223 ft). All observations were within the Walnut Creek riparian zone or adjacent to the riparian zone. There were no mice observed in drier areas such as those on top of the pediment in the xeric tallgrass prairie.

Travel Distances in Rock Creek: After 1998 data were reevaluated, the average distance a mouse traveled between 24-hour observations in the first session was found to be 171 m (561 ft; n = 94 observations). The maximum distance traveled between 24-hour observations was 940 m (3,084 ft). The recalculated average distance a mouse traveled between 24-hour observations in the second session was 95 m (312 ft; n = 29 observations). The maximum distance traveled between 24-hour observations was 713 m (2,339 ft).

The linear stream reach used in Rock Creek over the 1998 telemetry session (20+ days) is intended to provide an estimated length of stream used by individual mice in summer.

The average distance used was 873 m (2,864 ft, 0.54 miles; $n = 6$) of stream during the first session and 505 m (1,657 ft, 0.31 miles $n = 2$) during the second session. The maximum distance observed over both sessions was 1,492 m (4,895 ft, 0.93 miles) of stream.

The maximum perpendicular distance away from the Rock Creek stream channel at which an individual in 1998 was observed was 233 m (764 ft). All observations were within the Rock Creek riparian zone and seep wetlands, or adjacent to the riparian zone. There were no mice observed in drier areas such as those on top of the pediment in the xeric tallgrass prairie.

Home Ranges: The home-range values for Preble's mice represent the first reported for this subspecies using radio telemetry. Home ranges were calculated for collared mice that were tracked for 20 days or longer in Rock Creek in 1998, although many of the mice in Rock Creek were tracked for more than 30 days. Home ranges were also calculated for collared mice that were tracked in Walnut Creek for 20 days or longer in 1999.

From 1998 Rock Creek data, six home ranges were calculated from the movements of adult males in summer. Overall, the home ranges that result from normal summer activity, which would include breeding, resting, and foraging, range from 1.4 hectares to 5.7 hectares (3.6 to 14.3 acres), with a mean of 4.3 hectares. The remaining two individuals' home ranges result from movements of a male and a female prior to hibernation. The small home range of the pre-hibernation male (0.2 hectares; 0.5 acres) illustrates the declining activity just prior to hibernation. The female's home range (2.7 hectares, 6.9 acres) likely illustrates the roaming that may occur in searching for a hibernation site. These Rock Creek home ranges are considerably larger than those seen in the Walnut Creek area.

The Walnut Creek home-range calculations are the result of movements of two adult males and six adult females in summer of 1999. The resulting summer home ranges vary from 0.6 to 2.8 hectares (1.6 to 7.1 acres). The mean summer home range for Preble's mice in Walnut Creek was 1.5 hectares.

Preble's Mouse Nests: Second-session mice were tracked to three different types of nests: daytime nests, a natal nest, and a probable hibernation site. Daytime nests were found in all areas trapped. They were always above ground and usually made of grass. Daytime nests were typically along the edge of shrubs, but never too far from the stream (0.5 to 10 m). One nest, at the B-4 pond, was found in cattails. This nest was only a short distance (2 m) from grassy vegetation on one side of a large cattail patch.

The natal nest was located in thickly covered shrub vegetation, coyote willow, short shrubs, and weeds. The entrance was located 1 m from the stream and about 1 m above the water level. The inner chamber was approximately 10 by 8 cm, at a depth of about

8 cm below ground level. The natal nest had five deceased young inside. The young were all fully furred, weighed about 2 g each, and were 40 mm long.

A probable hibernation site was located by tracking a female in Lower Walnut Creek. Personnel did not disturb the chamber, but the general location was found on a steep north-facing slope (approximately 40°) about 1 m from the creek. The site was covered thinly by grass and some snowberry. The entrance was plugged with dirt, and seemed to extend upward to a hibernaculum. A tunnel configuration such as this may prevent water from entering the hibernation chamber even if the burrow entrance is covered by flood-water.

Walnut Creek Habitat Characterization Results: Vegetation and physical measurements were made to describe some of the abiotic and biotic characteristics at successful trapping transects in new locations. Vegetation and physical measurements were made at four transects where Preble's mice were captured in 1999, as well as at the 1999 nest sites and a probable hibernaculum, to describe Preble's mouse habitat in Walnut Creek.

Vegetation and physical habitat characterization measurements in the Walnut Creek drainage during 1999 were generally all within the range of values observed previously at other Preble's mouse capture locations (transects) within the Site. Using a one-way analysis of variance (SigmaStat 1997), the 1999 data were compared to data collected from Rock Creek in 1998 and Woman Creek in 1997. The number of species per trap-station in Walnut Creek was significantly lower than that found in either Rock Creek or Woman Creek. This is largely related to the more disturbed condition and more uniform mosaic of adjacent plant communities found in conjunction with the riparian habitat in Walnut Creek. Short shrub cover differences were found between Walnut Creek, where large amounts of snowberry and wild rose are common, and Woman Creek, where smaller amounts of these species are found.

Nest location characterization data showed a high similarity to general Preble's mouse habitat characterization results. Like successful transects, nest locations were found in areas with high herbaceous cover and moderate woody cover, which would provide good protection from predators. The herbaceous density and tree and shrub canopy measures were also similar to those found along the transects. No outstanding differences were noted among any of the measures.

One probable Preble's mouse hibernaculum was evaluated during 1999. Comparison to general Preble's mouse habitat characterization results showed fairly high similarity, although caution must be used in the comparison because only one plot, analogous to a single trap-station, was monitored for the hibernaculum habitat characterization data. The most notable differences were that herbaceous density, a measure of horizontal vegetation cover or thickness of vegetation, was only about one-fifth of that typically found in Preble's mouse habitat, and no tall shrub cover was present at this location. The habitat characterization data for a hibernaculum discovered near the B-4 dam area in 1995 were reexamined for comparison to the 1999 location. While there are some similarities between the two locations, several differences are apparent. Both

hibernaculum locations were found on steep ($>40^\circ$ slope), northerly facing aspects. The same number of plant species (21) was found within a 3-m radius of each of the two hibernacula. Tree canopy was similar at both locations, with approximately 10 percent found at the 1995 location and 15 percent at the 1999 location. Tall shrub cover dominated the 1995 location (60 percent), whereas no tall shrub cover was present at the 1999 location. Short shrubs were present at both the 1995 and 1999 locations, providing about 15 percent cover at each site. Very little herbaceous cover was present at the 1995 location, while herbaceous cover provided nearly 65 percent cover at the 1999 location. Perhaps most significant, however, is the location of the 1999 hibernaculum in relation to the stream. The 1995 hibernaculum was found "at the toe of a steep slope, above the riparian zone, at 20 m from the stream" (K-H 1996). The 1999 hibernaculum was found approximately 1 m above the stream itself, in an embankment, and about 1 m away from the stream, well within the flood zone.

Preble's mice were more numerous and more widely distributed than expected in Walnut Creek during the 1999 study. Mice were captured in the A-series, the B-series, and the lower section of Walnut Creek. Mice were captured in the A-series, not only in the habitat patch above the A-1 Pond, but also above the A-3 Pond. Additionally, two mice were observed moving from above the A-1 pond to the A-2 pond inlet. Likewise in the B-series, one mouse was captured above the B-1 pond, and two mice were captured above the B-4 pond. These captures were unexpected because trapping in 1995 (DOE 1995, 1996) in similar areas indicated no mice above the B-4 Dam. However, areas of habitat do exist and have been mapped as protected areas (Figure 5), so where there is enough habitat available, Preble's mice can inhabit these areas, even if only seasonally. Telemetry in the B-series also illustrated how Preble's mice can use a large portion of the stream reach, despite the fact that the habitat is divided by segments of ponds and dam faces. These reaches in the A- and B-series have a discontinuous distribution of habitat because of the ponds and dams. However, individuals have been tracked crossing dirt roads and grass dam faces, and moving around ponds to travel up- and downstream.

Mice were also captured in the lower section of Walnut Creek. Four individuals were captured, which is significant because Preble's mice had been captured there in 1993 (EG&G 1993), but subsequent trapping efforts did not detect any mice (DOE 1995, DOE 1996, K-H 1997a). This may indicate the transitory nature of populations or groups of mice from year to year. Preble's mice have the ability to move great distances and may emigrate from area to area. Or mice may die out in an area only to have the next generation thrive in a new location.

It is noteworthy that the telemetry data from both creeks show home ranges of male Preble's mice that have considerable overlap, with some large home ranges almost completely containing smaller ranges. Small mammals, in general, tolerate home-range overlap and can thrive in areas of high animal density (Mares and Lacher 1987). Specific to Preble's mice, this overlap may be a function of age, in that older, more established individuals have the smaller home ranges in the higher quality habitat, whereas the more wide-ranging younger individuals may need to use more area, often overlapping others' home areas, in the course of using lower-quality habitat.

3.1.9 Migratory Birds

Migratory birds are monitored using two methods: migratory bird transect surveys, and multi-species census surveys. Each method collects different combinations of data, and each provides specific types of information on species population trends and habitat use.

As of 1999, 194 species of birds have been recorded at the Site. Among all survey methods, 125 species of birds were recorded on the Site in 1999. Three new species were recorded: the great egret, black vulture, and the orange-crowned warbler (*Vermivora alata*). At present, 74 species of birds have been confirmed or are suspected of breeding at the Site. Confirmed breeding species are those species that have been observed building nests or tending eggs or young, or for which young, flightless nestlings have been observed. Suspected breeding species are those that have been observed carrying nesting material, food, or other such indicators of breeding activity without actual visual confirmation of the presence of a nest or young. Among the 103 species of neo-tropical migrants known to use the Site, 45 are confirmed or suspected breeders at the Site.

Relative abundance categories of all bird species using the Site since 1991 are shown in Table 3-16. This table is based on observed bird distribution by habitat during migratory bird surveys, multi-species census surveys, sitewide surveys, project-specific surveys, and fortuitous observations. This summary table shows a running tally of species recorded at the Site since 1991, and presents relative abundance categories (e.g., abundant, common, rare, etc.) in appropriate habitats for each species. The table does not estimate total population numbers of each species inhabiting the Site, but is intended as a cumulative summary of birds observed by all methods at the Site. Note that some species are very habitat specific, while others are ubiquitous.

Evaluation of habitat use by birds, as indicated by data from cumulative combined records for all observation methods since 1991, yields different total species numbers for the different habitats than the species richness data from bird surveys alone (discussed below in Section 3.2.2). Based on all combined data, 194 bird species have been recorded at the Site at some point in time. Bird species richness in the major habitats at the Site is 93 species in grasslands, 88 species in tall upland shrubland, 80 species in riparian shrubland, 114 species in riparian woodland complex, 118 species in wetlands, and 51 species in disturbed habitats (Table 3-16). Seasonal use also varies, with the greatest species richness observed during spring and fall (142 and 119, respectively), and lowest richness in winter (56).

3.1.9.1 Bird Relative Abundance from Multi-Species Census Surveys

Assessment of relative abundance is a means of determining relative numbers of species within various habitats and sitewide. The 1999 multi-species survey results for migratory birds (exclusive of waterfowl and raptors, which were discussed in previous sections) were analyzed for relative abundance of species within specified habitats by season,

sitewide by season, and sitewide for the year. Comparisons made in the following sections are based on relative abundance of species within habitats and sitewide. Table 3-17 shows seasonal and annual summaries of bird relative abundance sitewide.

Year-Round Sitewide Bird Relative Abundance — As shown in Table 3-17, the red-winged blackbird (*Agelaius phoeniceus*) was the most abundant migratory bird species across the Site in 1999. Relative abundance of this species in 1999 was 0.172 o/m, compared to 0.1489 o/m in 1998 and 0.1707 o/m in 1997. European starling (*Sturnus vulgaris*) observations in 1999 decreased to about half the abundance observed in 1998 (0.0531 o/m versus 0.168 respectively). Such abundance of this Eurasian invader is a cause for concern, because this species affects many of the neotropical migrants that are commonly known to be declining in numbers across their entire range. House finches, though still abundant, dropped to fourth most abundant year-round (0.092 o/m in 1999; 0.1359 o/m in 1998; 0.2109 o/m in 1997). Because finches as a group are highly migratory throughout the year, fluctuations in the abundance of this group can be expected. Several other species are also quite abundant at the Site, largely on a seasonal basis. These species include the western meadowlark (*Sturnella neglecta*) (0.111 o/m in 1999; 0.1034 o/m in 1998), vesper sparrow (*Pooecetes gramineus*) (0.093 o/m in 1999; 0.0928 o/m in 1998; 0.0898 o/m in 1997), song sparrow (*Melospiza melodia*) (0.039 o/m in 1999; 0.0437 o/m in 1998), and barn swallow (*Hirundo rustica*) (0.046 o/m in 1999; 0.0399 o/m in 1998). Cliff swallows (*Hirundo pyrrhonata*) have fluctuated from 0.1125 o/m in 1997, to 0.0143 o/m in 1998, to 0.015 o/m in 1999. Note that these trends are not the same as those shown for some of these species using different data-gathering methods discussed in the next section.

Spring Bird Relative Abundance — Sitewide species richness of birds was greatest in spring and summer (42 species), and a wide diversity of habitats (14) were used in spring (Table 3-17). A number of the migratory species became abundant or common as the season advanced. One species that had not been recorded at the Site previously, the orange-crowned warbler, was recorded for the first time in spring 1999. The most abundant species, as in previous years, were the western meadowlark (0.201 o/m in 1999; 0.213 o/m in 1998; 0.151 o/m in 1997) and the red-winged blackbird (0.239 o/m in 1999; 0.190 o/m in 1998; 0.172 o/m in 1997). European starlings decreased in relative abundance from 0.180 o/m in 1998 to 0.061 o/m in 1999, and house finches showed natural fluctuation (0.038 o/m in 1999 compared to 0.087 o/m in 1998 and 0.076 o/m in 1997). These species were followed in abundance by the vesper sparrow (0.177 o/m in 1999; 0.072 o/m in 1998), song sparrow (0.06 o/m in 1999, 1998, and 1997), and American robin (0.044 o/m in 1999; 0.049 o/m in 1998). Cliff swallows (*Hirundo pyrrhonota*)—with a relative abundance of 0.009 in 1999 (0.014 o/m in 1998; 0.264 o/m in 1997)—and barn swallows (*Hirundo rustica*), which had a relative abundance of 0.042 o/m in 1999 compared to 0.010 o/m in 1998 and 0.053 o/m in 1997, demonstrated the year-to-year fluctuations typical of migratory species.

Habitat preferences for the various species corresponded to the niches filled by each. American goldfinches and house finches were found most commonly in riparian woodland/shrubland (49 percent and 69 percent, respectively). Red-winged blackbirds typically preferred marshlands (74 percent) and riparian areas (24 percent). Northern orioles (*Icterus glabula*) used riparian woodland heavily (71 percent). Song sparrows divided their time among riparian woodland/shrubland (30 percent), marshland (31 percent), and tall upland shrubland (39 percent). Black-billed magpies spent fairly equal time in riparian woodland/shrubland (45 percent) and tall upland shrubland (42 percent). Vesper sparrows and grasshopper sparrows (*Ammodramus savannarum*) were observed more often in grasslands (69 and 50 percent, respectively) than in other habitats. Western meadowlarks divided their time largely between grasslands (49 percent) and riparian woodland/shrubland (24 percent), probably because of the abundant perch-points offered by woodlands. European starlings, as in other seasons, preferred riparian woodlands (72 percent), and mourning doves were also recorded most often in the woody vegetation of riparian communities (74 percent).

Summer Bird Relative Abundance — Bird species richness in summer was the same as in spring (42 species; Table 3-17). Species with the greatest recorded abundance were red-winged blackbird (0.353 o/m in 1999; 0.323 o/m in 1998), house finch (0.226 o/m in 1999; 0.283 o/m in 1998), vesper sparrow (0.186 o/m in 1999; 0.155 o/m in 1998), and western meadowlark (0.165 o/m in 1999; 0.113 o/m in 1998, still lower than the 0.203 o/m recorded in 1997). The European starling relative abundance was lower in 1999 (0.102 o/m) than in 1998 (0.383 o/m). Cliff swallow observations (0.045 o/m) demonstrated the normal fluctuation of migratory species (compared to 0.123 o/m in 1997 and 0.038 in 1998). Most other species also showed variance from the relative abundances recorded in previous years (K-H 1998c; K-H 1999).

Over 50 percent of the red-winged blackbirds were recorded in tall marsh. Grasshopper sparrows preferred xeric and mesic mixed grassland in 66 percent of observations. Finches were most commonly observed in riparian woodland/shrubland (house finch, 53 percent; lesser goldfinch, 83 percent; and American goldfinch, 46 percent). Tall upland shrubland was the second most favored habitat for this group. Swallows were recorded around water or along riparian woodland/shrubland habitats the majority of the time in summer. Song sparrows spent the majority of their time in woody habitat as well, with 40 percent of observations in riparian woodland and 33 percent in tall upland shrubland. Rufous-sided towhees (*Pipilo erythrophthalmus*) were observed almost exclusively in tall upland shrubland (99 percent). As in other seasons, black-billed magpies divided most of their time between riparian woodland/shrubland (28 percent) and tall upland shrubland (60 percent). Vesper sparrows (54 percent) and western meadowlarks (31 percent) favored grasslands, although western meadowlarks used riparian habitat heavily as well (44 percent). As in other seasons, European starlings were most frequently observed in riparian woodland (91 percent). During the summer, American robins continued to show their affinity for woody habitats (42 percent riparian and 48 percent tall upland shrubland).

Fall Bird Relative Abundance — Fall of 1999 found 35 species recorded during the multi-species surveys (Table 3-17). The most abundant species changed somewhat from the earlier seasons; most abundant were house finches (0.061 o/m, similar to the 0.134 o/m in 1998) and black-billed magpies (0.06 o/m), followed by western meadowlarks (0.047 o/m), vesper sparrows (0.036 o/m), and song sparrows (0.029 o/m).

Habitat preferences remained similar to other seasons, with house finches, black-billed magpies, and song sparrows preferring woody habitats (82 percent, 94 percent, and 90 percent, respectively). Vesper sparrows were divided among grasslands (59 percent), wetlands (6 percent), and woody habitats (26 percent). Western meadowlarks were observed predominantly in woody habitats (71 percent) and grasslands (18 percent), the reverse of records in 1997. The affinity of European starlings for riparian woodland remained consistent (98 percent).

Winter Bird Relative Abundance — Nine bird species were observed sitewide during winter 1999 multi-species surveys. Some were winter residents, some were early migrants, and the remainder were year-round residents. Most species observed during winter were seen predominantly in woodlands and shrublands. The exceptions were species that are normally associated with grasslands or wetlands. Approximately 91 percent of the horned lark (*Eremophila alpestris*) and 100 percent of western meadowlark observations were in grasslands. The most common winter species during 1999 was the black-billed magpie (relative abundance = 0.081 o/m). Although this species was observed in a variety of habitats, the great majority of observations were in woody habitats (81 percent). Another species found predominantly in woody habitats was the American tree sparrow (*Spizella arborea*) (relative abundance = 0.022 o/m), of which 96 percent of observations were in these habitats. Northern flickers (*Colaptes auratus*) (0.015 o/m) preferred riparian woodland/shrubland (94 percent). Black-capped chickadees (*Parus atricapillus*) continued using woody habitats in the same percentages as in 1998 (riparian woodland/shrubland at 40 percent; tall upland shrubland at 60 percent). Song sparrow (*Melospiza melodia*) relative abundance of 0.007 o/m remained comparable to 1998 at 0.008 o/m and 1997 at 0.007 o/m; habitat use was similar.

3.1.9.2 Migratory Bird Survey Summaries

The goal of monitoring the bird communities on the Site is to detect significant changes or observe significant trends in the number of birds present or in the bird assemblages of the general habitats or seasons. Several years of migratory bird survey data, from surveys performed along 18 permanent transects at the Site, were evaluated. Data sets were analyzed to search for trends in species richness (number of species) and bird diversity by habitat during each season or annually, and by season regardless of habitat. Bird densities (individuals per square kilometer) were calculated for each of three general habitats, and by season regardless of habitat. Simpson's diversity indices were calculated for bird assemblages during June (breeding season) and all four seasons. Data collected during 1999 were compared to seven years of previously reported data (DOE 1992;

EG&G 1994, 1995a; RMRS 1996; K-H 1998, 1999) to examine trends in these parameters. The discussions below include analyses of data from breeding season, summer and winter seasons, and migration season (spring and fall).

During 1999, 85 bird species were recorded on migratory bird surveys alone. Fifty-four of these species (63 percent) were neo-tropical migrants. This large percentage of neo-tropical migrants using the Site demonstrates the importance of the habitats provided by the Site to this sensitive group of bird species

Bird Community and Species Density Analyses — Quality assured data sets from 1991 and 1993–1999 were analyzed using three community measures: species richness, species diversity, and population densities. A modified Simpson's Index was used as a measure of diversity (Hair 1980). Bird density was calculated as number of individuals per square kilometer of each bird species using the total transect length and a 50-m width on either side of the transect (100 m wide).

Calculations were done by habitat, as well as for sitewide observations, for the entire year and for specific seasons. Habitat types were combined into three general categories based on prior-year analyses of bird community similarity that used the Jacard coefficient of similarity (Digby and Kempton 1987). These past analyses revealed that the structure of the habitat is essential in determining the composition of a bird community in a particular place. The plant species composition of any particular habitat is of lesser importance (i.e., grasslands of different plant species compositions, but similar structure support similar bird communities). Where the structure is different (e.g., grasslands versus woodlands), the composition of the bird communities are different. With consideration of these past analyses, habitats were grouped into the general categories of grasslands, woodlands/shrublands, and wetlands.

The data sets were standardized to eliminate observations beyond 50 m, particularly when calculating bird densities. Observations beyond 50 m are considered less reliable in terms of the number of individuals observed and may not be representative of bird communities in linear habitats (e.g., riparian woodlands). For an explanation of how birds on the wing were handled, refer to Appendix C.

Bird Community Measures: Diversity, Species Richness, and Similarity — The Simpson's diversity index (D') is used as a means of comparing among habitats and from year to year. The index takes into account both the number of species present and the relative abundance of those species. Generally speaking, more species in greater abundance will raise the value of the index. However, the index artificially emphasizes an even distribution of abundance across species, so observations of a species that forages in flocks, compared to a species that is normally solitary, will have the effect of lowering the index for a given habitat. No diversity index should be treated as a simple value judgment. Higher diversity is not always "better" (the addition of non-native species is

an example). The following discussions of seasonal bird diversity are based on data collected during migratory bird surveys.

Diversity indices reflect the number of available niches in the different habitats. A woody habitat provides more niches within its three-dimensional, multi-strata environment than do grasslands. Therefore, the apparent correlation of species diversity to niches per habitat type is expected, as discussed below.

Species richness is the simple tallying of the bird species present within a particular habitat (e.g., mesic grasslands) or during a certain time interval (e.g., winter season). Changes in species richness over time can reveal additions or losses to bird assemblages, and may drive changes in diversity indices. However, entire shifts in the makeup of assemblages can be missed if the *same* number of *different* species are observed in data sets. For this reason, it is also useful to compute a similarity index (Jacard's coefficient) to detect a change in similarity from year to year.

All three of these measures have been used to track changes to the dynamic bird communities on the Site. These measure were used in monitoring birds from year to year regardless of habitat and within each of the seven habitats present at the Site, for each season, limiting data sets to observations within 50 m of the transect centerline and selected flyovers.

Bird Community Measures Across the Site: Species richness across the site during 1994–1999 (Figure 3-15), regardless of habitat and season, exhibits a trend toward stabilized richness. The years 1991 and 1993 were not included in this Site summary, because these data sets only include surveys from winter and June.

The diversity of birds across the site, as indicated with the Simpson Index, has remained at a steady state for the last six years. Within each year, there is far more variability among the different seasons and habitats, but in tracking diversity from year to year, nearly no variability is observed.

Species richness and bird diversity were calculated and compared between each year within each season, regardless of habitat. During each season, trends in species richness are all nearly level, with no large increases or decreases. Bird diversity during each season shows slight increases over time, with the exception of winter bird diversity, which shows the greatest fluctuation (Figure 3-16). The migration seasons also show some fluctuations in diversity over time, as would be expected. As species migrate through the Site, diversity from day to day can fluctuate widely. This sampling effort does not attempt to document this phenomenon, as it is already well known.

Bird Community Measures in Habitats within Seasons: Community measures of species richness and diversity varied across habitats within each season. Overall, richness and diversity show only slight increasing or decreasing trends, and the variability normally associated with year-to-year differences in weather patterns. However, there were some exceptions to this normal variability during the spring migration season. Diversity,

species richness, and density all show a downward trend in grasslands during spring, with low diversity values in 1998 and 1999 of 0.71 and 0.72, respectively (Table 3-18); lows in species richness of 21 in 1996, 20 in 1998, and 19 in 1999 (Table 3-19); and low bird density of 159 and 139 birds/km² in 1996 and 1999 respectively (Table 3-22).

Woodland/shrubland diversity in spring shows a slight increasing trend from a low of 0.91 in 1994 to 0.94 in 1999 (Table 3-18). Densities in grasslands and woodland/shrubland habitats in fall show a decreasing trend (Table 3-20), while fall species richness in woodland/shrublands is quite variable from year to year (Figure 3-15).

In general, these variations in the monitoring endpoints during the migration seasons are not surprising. Species richness and abundance of birds during migration are known to be highly variable, and this phenomenon is well documented. Additionally, from a monitoring viewpoint, migration values are not as meaningful in assessing the effects of Site activities as other values such as those from the breeding season. During the breeding season, birds are temporarily residents at the Site, and as such are more likely to be affected by Site activities. Bird monitoring endpoints associated with the breeding season (i.e., summer and especially the month of June), have much more potential to reflect affects of Site activities, because most bird species are acquiring most or all of their resources from habitats on or near the Site.

It is interesting to note that none of these downward trends were seen during the summer or winter months. The trends for diversity, species richness, and density were all relatively stable during summer and winter when bird species are effectively residents in the Site (Tables 3-18 through 3-20).

Bird Community Measures for Breeding Birds in June: Figure 3-17 graphically depicts June bird species diversity by habitat for all years analyzed. The site habitats with the greatest bird diversity are the woody habitats, such as riparian woodlands, lead plant (*Amorpha fruticosa*), riparian shrublands (*Salix exigua*), and tall upland shrubs. The grasslands generally support less diversity than woodlands, but also have a very different assemblage of birds. Wetlands support the least diversity during the breeding season due to the dominance of one species, the red-winged blackbird, and the smaller number of available niches. Wetland vegetation on the Site tends to be dominated by a few characteristic plants, such as rush (*Juncus* sp.) or cattails (*Typha* sp.), and therefore does not have diverse habitat within these plant communities in terms of niche availability.

Overall, the breeding season diversity indices for the Site for all habitats combined over the past eight sample years (1991, 1993–1999) show a steady state (Table 3-18). Most habitats within the Site show a similar steady track, with the exception of woodland/shrubland habitats, which show an upward trend in species richness (Figure 3-18) and a substantial downward trend in bird density (high of 664 birds/km² in 1993 to a low of 320 birds/km² in 1997 and 326 birds/km² in 1999; Figure 3-19 and Table 3-20).

The decrease in bird density in woodland/shrubland habitats during June is of monitoring interest. The decrease in densities of eight species accounts for most of the decline in overall density.

- Western meadowlarks
- Red-winged blackbirds
- House finches
- Brewer's blackbirds
- Barn swallows
- Mourning doves
- Red-tailed hawks
- American goldfinches.

Of all these species, only red-tailed hawks and American goldfinches normally use woodland/shrubland habitats as nesting habitat. Mourning doves use this habitat as roosting cover, but some mourning doves do nest in woody habitat. The other species really do not depend on woodland/shrubland habitat for nesting cover. However, the presence of these species, as observed in woodland/shrubland habitats, explains much of the decline in bird density during the breeding season. Correspondingly, one must ask if these species are declining in other habitats where they do nest. On further analysis, western meadowlarks show a decline in both wetland and grassland habitats, and red-winged blackbirds show a decline in wetlands. Overall, red-winged blackbirds and western meadowlarks show a decline in all habitats in June (red-winged blackbirds, high of 93.33 birds/km² and low of 47.79 birds/km² in 1996, and again, a low of 50.59 birds/km² in 1999; western meadowlark, high of 76.08 birds/km² and low of 42.79 birds/km² in 1999; Table 3-21).

By comparison, the relative abundances of mourning doves, western meadowlarks, and red-winged blackbirds, based on multi-species census surveys, all increased from 1998 to 1999 during this same season. Red-tailed hawk and Brewer's blackbird abundance remained virtually the same between 1998 and 1999. The presence of a single red-tailed hawk nest on a transect will considerably increase observations of the species along that transect during the period the nest is active. Finch species, as discussed previously, are highly migratory, and population concentrations are often transitory. As discussed in the previous section, both cliff and barn swallow numbers have fluctuated widely in recent years.

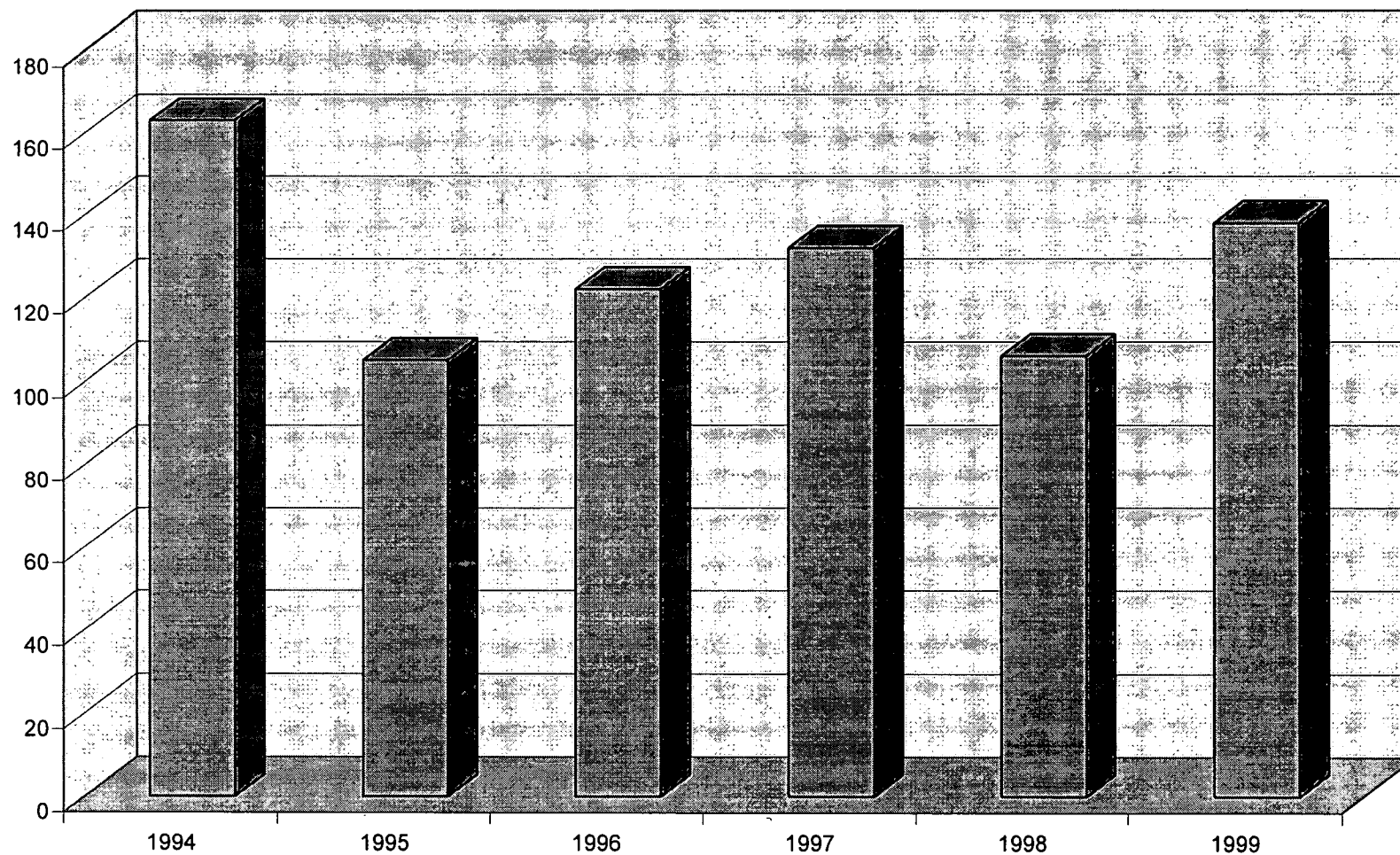
Were it not for the contradictory results from a second survey method, and the fact that several of these birds are highly migratory (finch species), or use this habitat more for secondary habitat (western meadowlarks are primarily grasslands birds, and red-winged blackbirds are largely marsh species), the decline in density of these bird species would warrant detailed investigation. With highly migratory species such as finches (e.g., American goldfinch; densities from 0.00 to 22.35 birds km²), the habits of the species must be examined before general conclusions can be drawn. Other species that are part-

time resident migrants (e.g., cliff and barn swallows) may be experiencing range-wide population fluctuations that are unrelated to Site conditions. Familiarity with the manner in which bird species actually use specific habitats can help determine whether the apparent trend should be cause for alarm. Should the trend of decreasing densities continue for several consecutive years without interruption, the cause will require more thorough investigation. In some cases, as mentioned in the discussion below, declines may be regional trends rather than localized impacts.

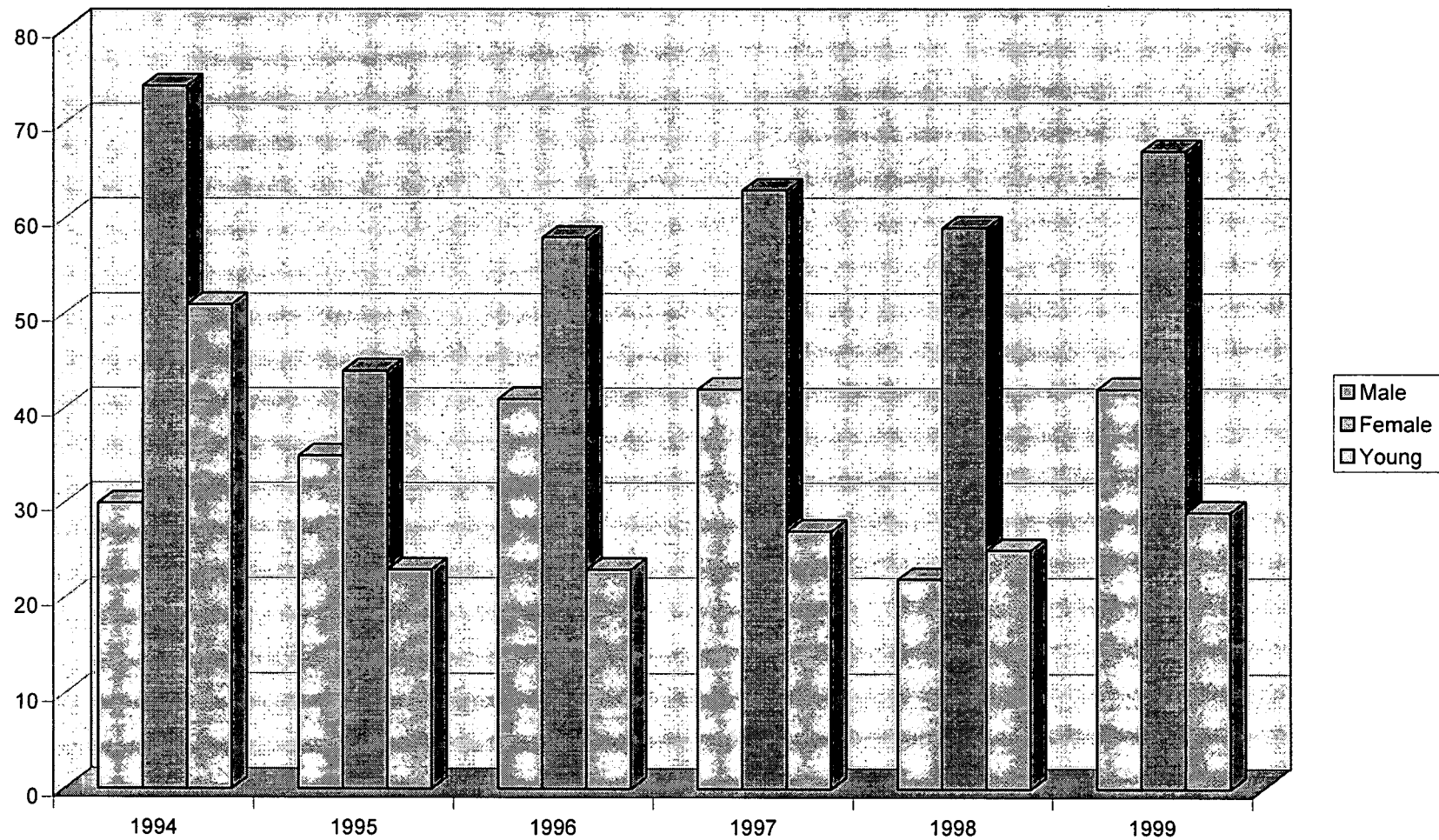
A subgroup of the birds, the neotropical migrants seen during the breeding season, are of special interest due to regionally declining numbers. This group of birds is characterized by species that travel to Central and South America to overwinter, and then return to breed in North America. Despite the overall decrease in density of two neotropical migrant species, the western meadowlark and the red-winged blackbird, the overall species richness of neotropical migrants in woodland/shrubland habitats has increased (Table 3-22). Observations other than declining trends for neotropical migrants are surprising given the regional declining trend of this bird group, and overall, the density of neotropical migrants on Site does show a slight downward trend from 1991 to the present (Table 3-23). However, over the most recent five-year period (1995–1999), densities for the group in general have been increasing. Neither trend is statistically significant.

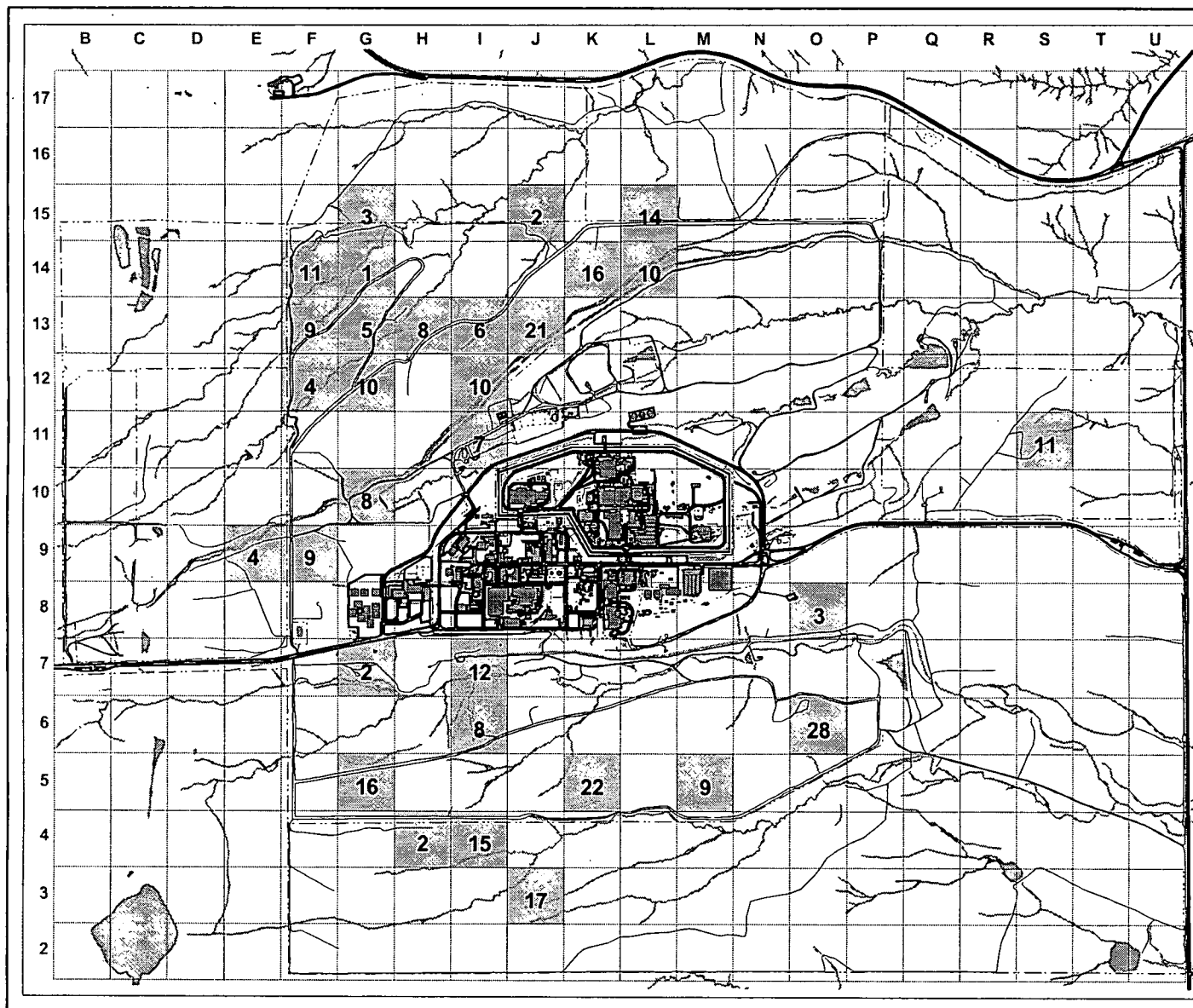
Recent studies in the Boulder Valley have demonstrated that only a modest level of land development (5–10 percent) can have significant negative impacts on bird utilization of a particular area (Bock 1999). The trend reversal at the Site demonstrates the importance of maintaining undeveloped lands, such as the Site, in the local conservation of birds.

FIGURE 3-1. TOTAL NUMBERS OF MULE DEER IN WINTER (1994-1999)

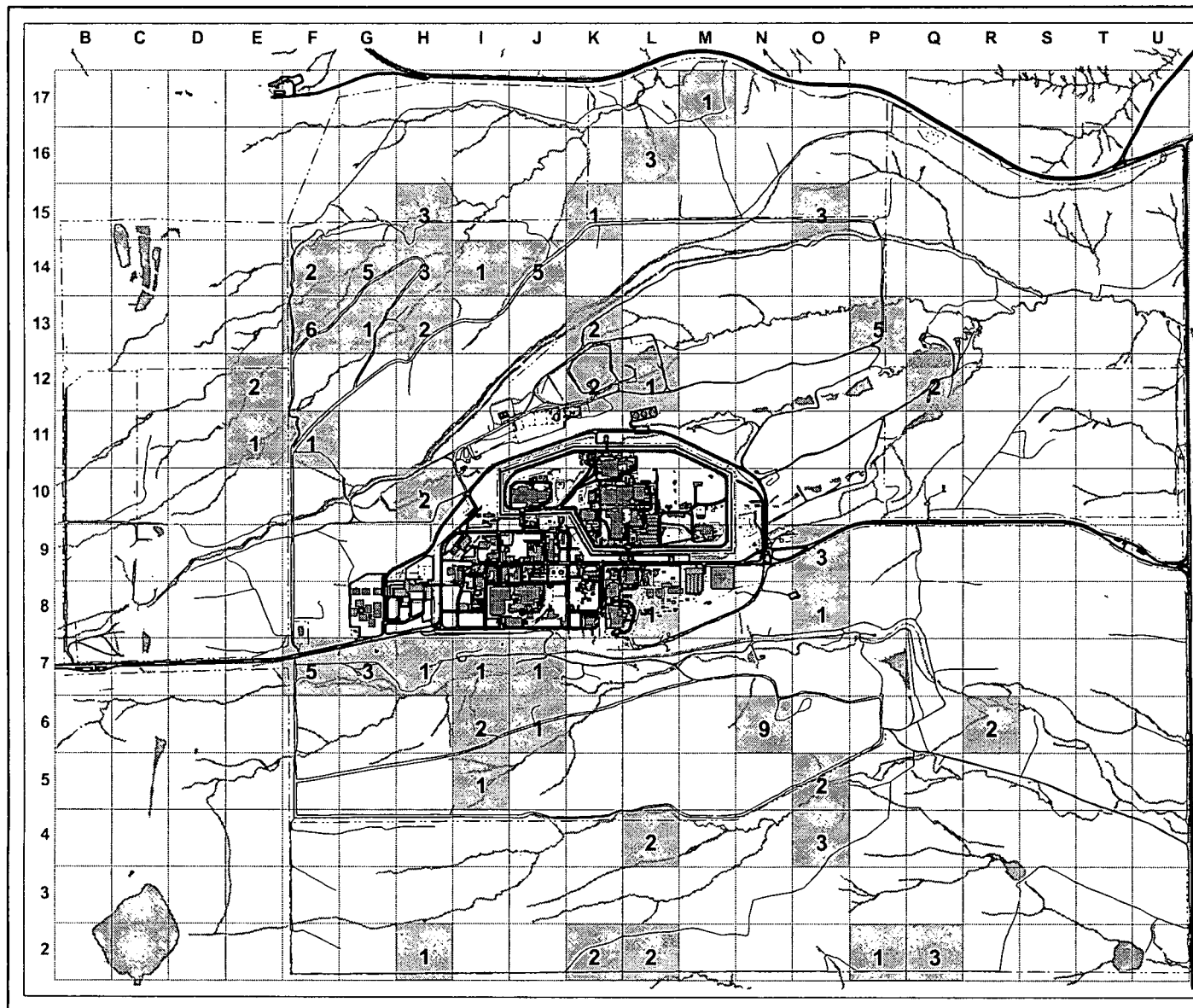


**FIGURE 3-2. ANNUAL MULE DEER POPULATION COMPARISONS FROM WINTER COUNTS
(1994-1999)**





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Mule deer area use
in summer.

Figure 3-4.

LEGEND

Mule deer use area.
(# = number observed)

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95



1:32660
1000 0 1000 2000 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared
by:

For:

Exponent

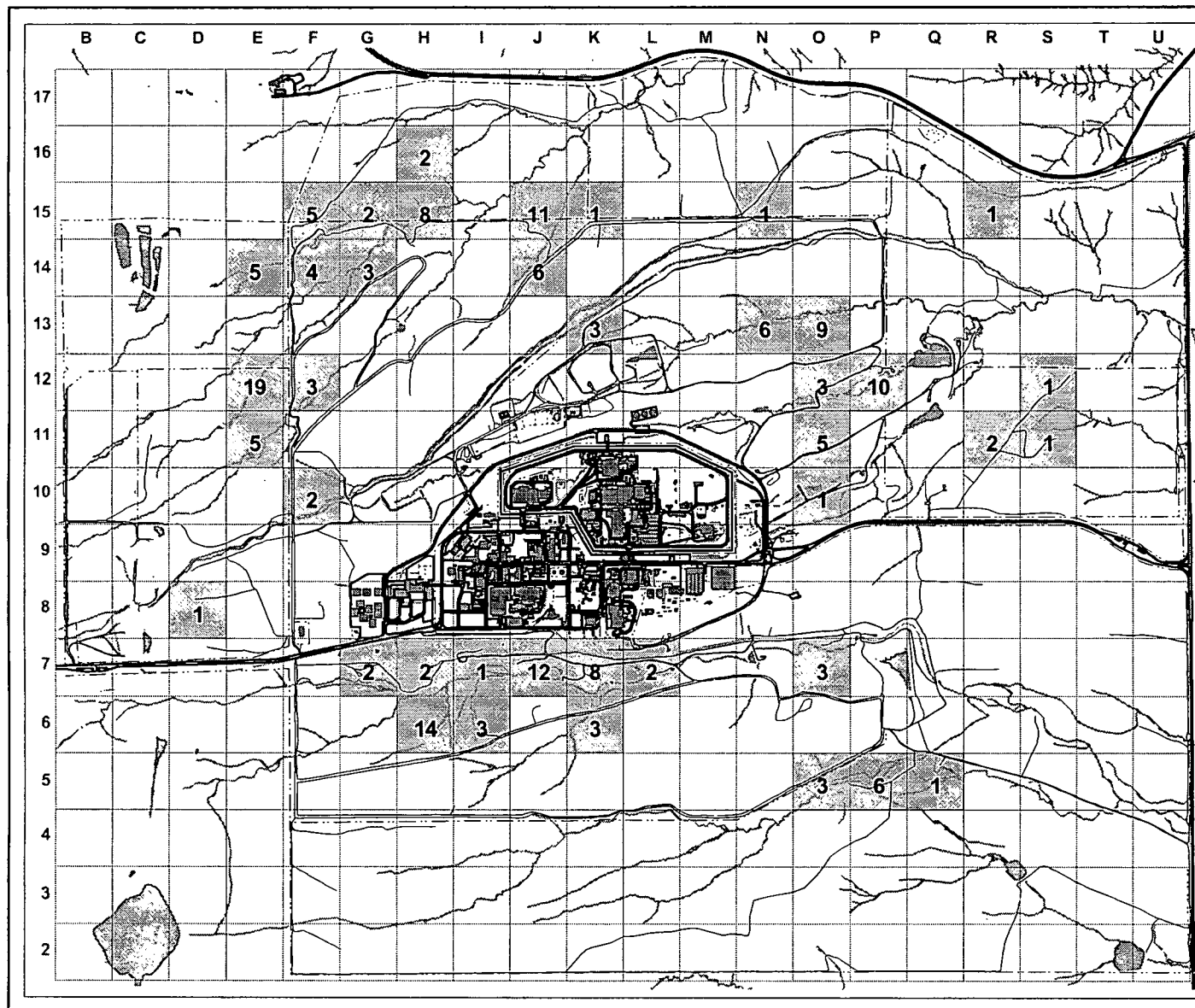


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May 1, 2000

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Mule deer area use in fall.

Figure 3-5.

LEGEND

Mule deer use area.
(# = number observed)

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/85



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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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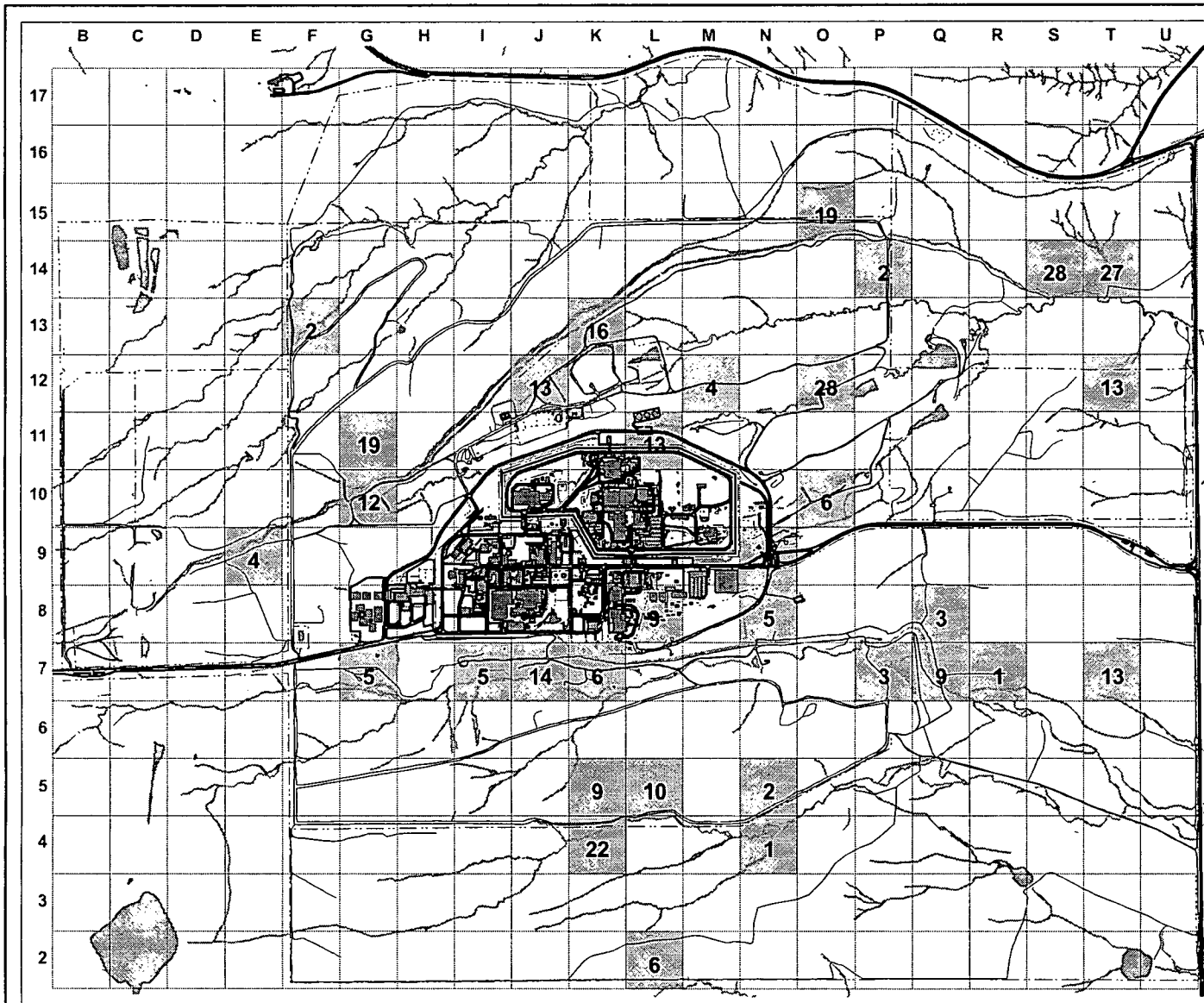


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Mule deer area use in winter.

Figure 3-6.

LEGEND

Mule deer use area.
(# = number observed)

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95



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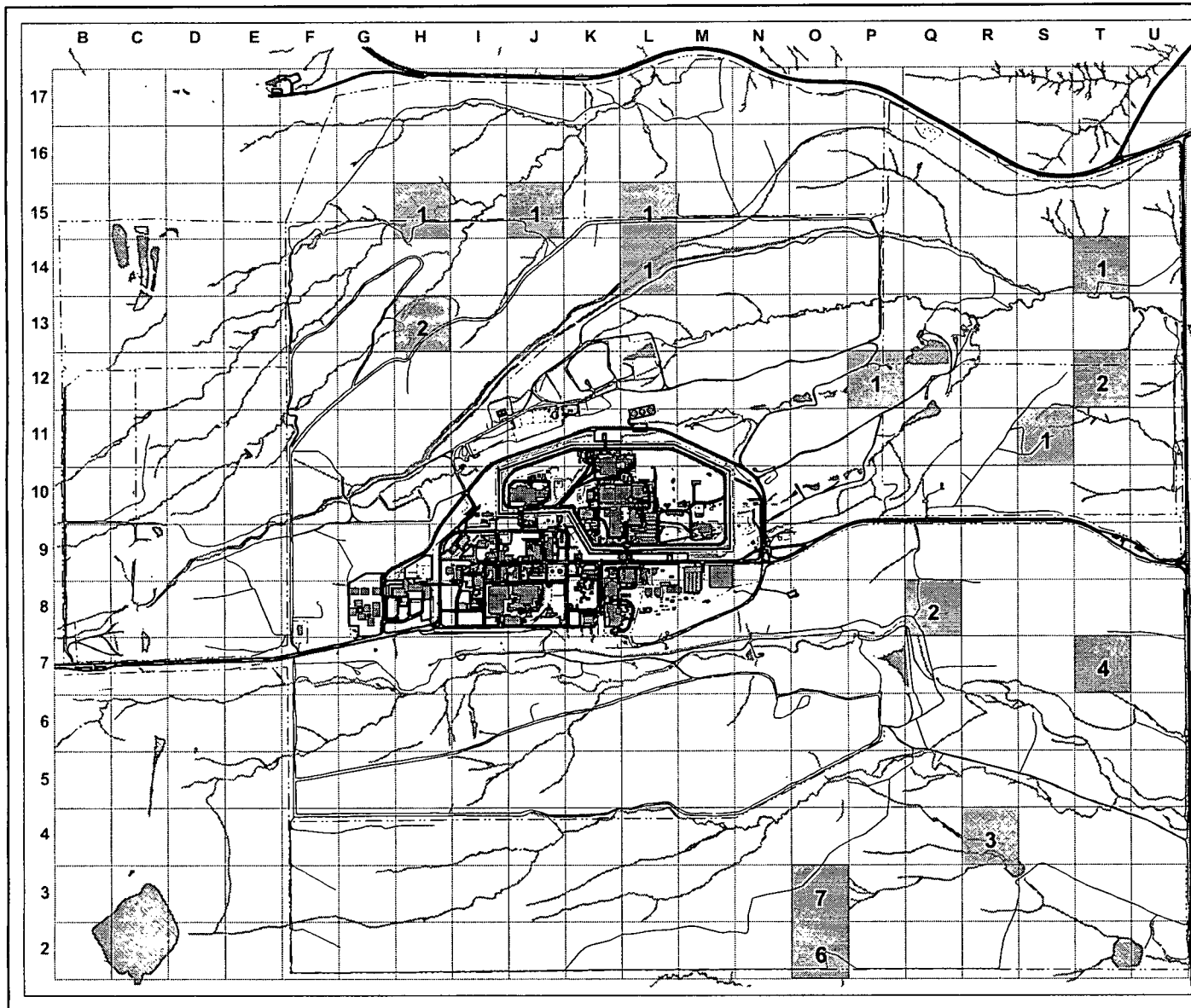
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May 1, 2000



White-tailed deer seasonal area use.

Figure 3-7.

LEGEND

- # Spring use area.
- # Summer use area.
- # Fall use area.
- # Winter use area.

(# = number observed)

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95

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State Plane Coordinate Projection
Colorado Central Zone
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Rocky Flats Environmental Technology Site

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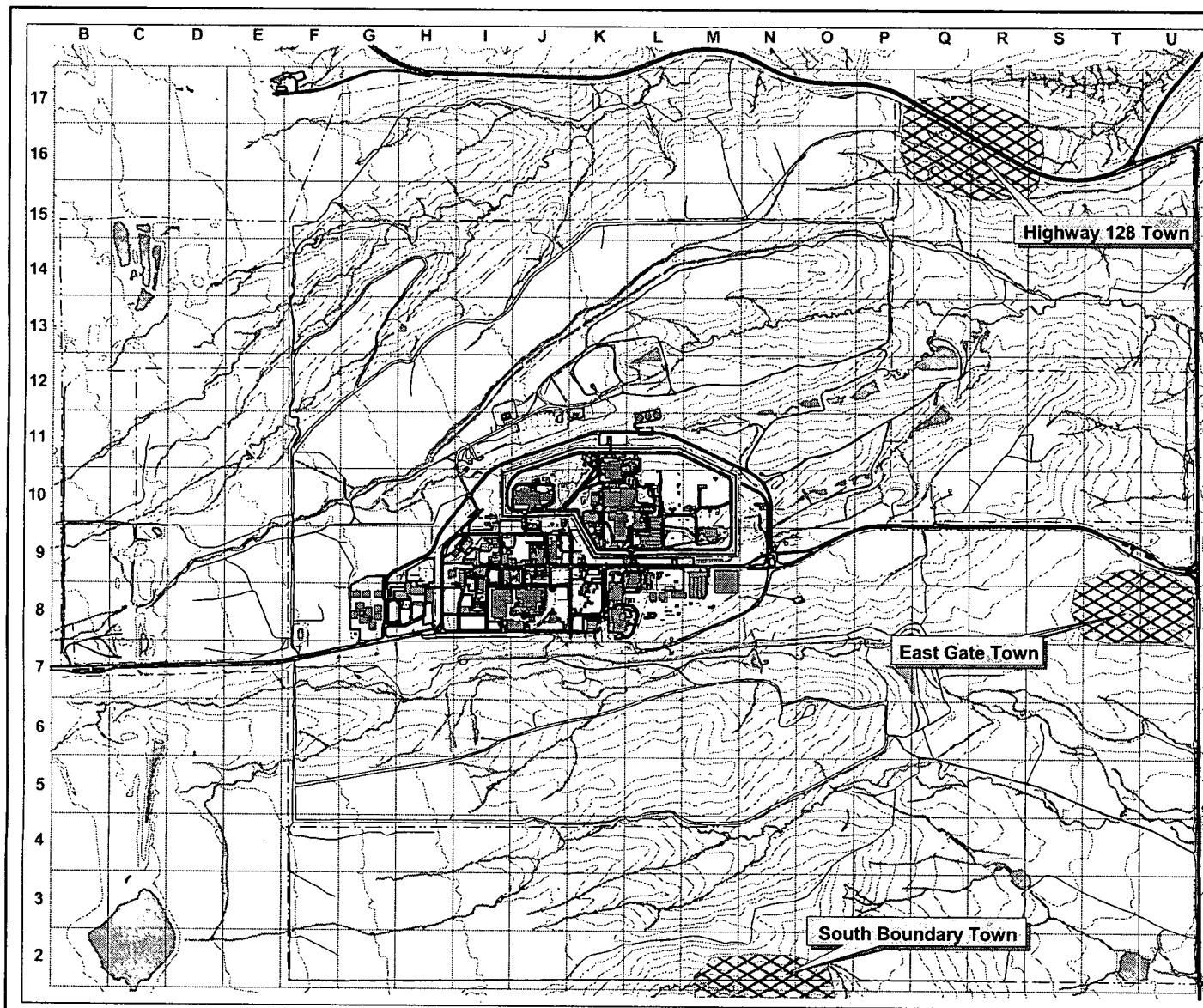


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MAP ID: 2K-0208

May 1, 2000

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Locations of recovering
black-tailed prairie dog
populations on the Site.

Figure 3-8.

LEGEND

- Approximate town locations
- Rocky Flats grid

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

Transect locations and lengths
are approximate.

DATA SOURCE:
Transects & grid provided by Exponent, 2000.
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95
Hypsography derived from digital elevation model
(DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN
and LATTICE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Remote Sensing Lab,
Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution.
The DEM post-processing performed by MK, Winter 1997.

N

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1000 0 1000 2000 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared
by:

For:

Exponent



Kaiser-Hill
Company, LLC

MAP ID: 2K-0208

May 8, 2000

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FIGURE 3-9. COMPARISON OF WATERFOWL SPECIES NUMBERS RECORDED AT ROCKY FLATS ANNUALLY (1993-1999)

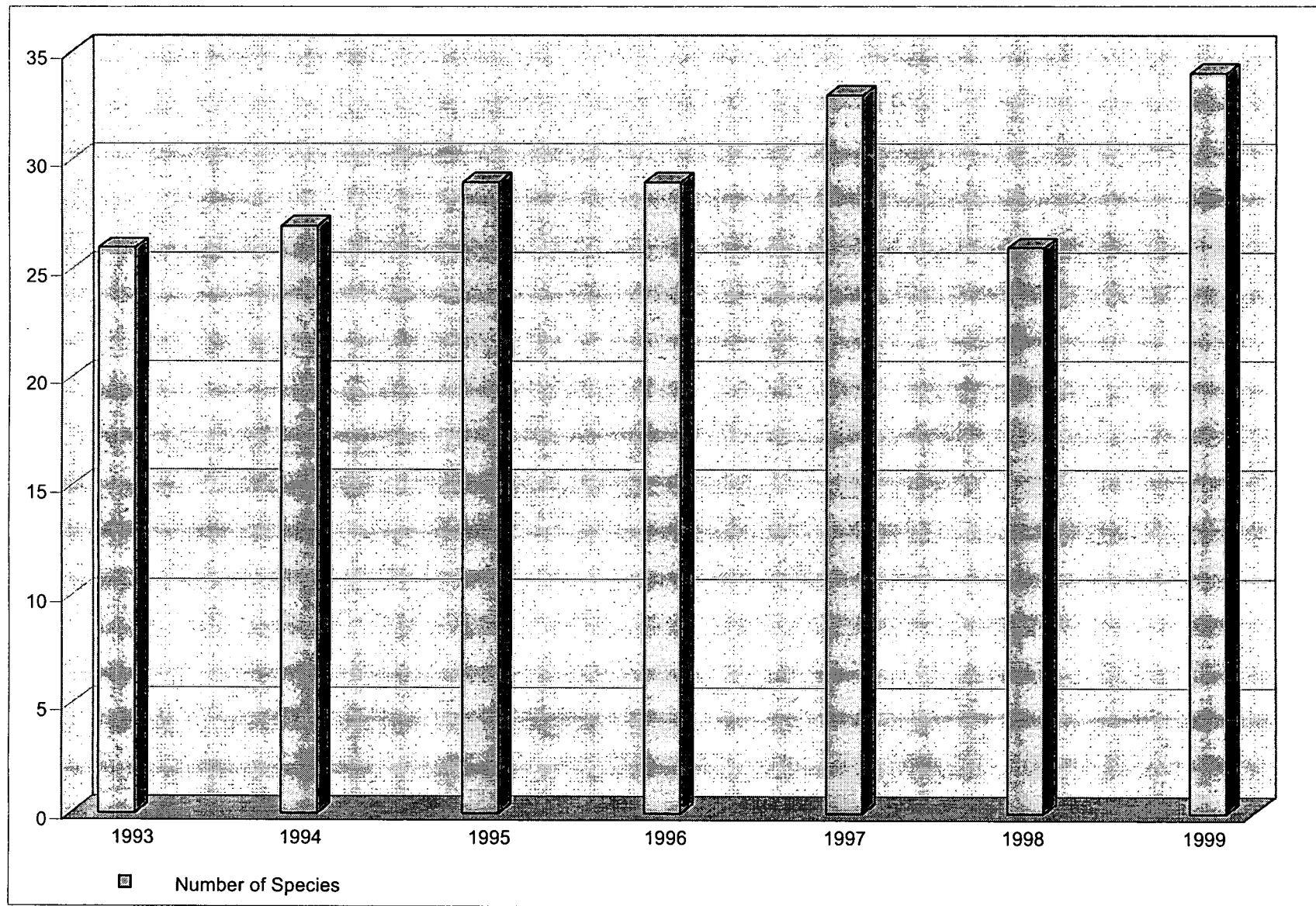
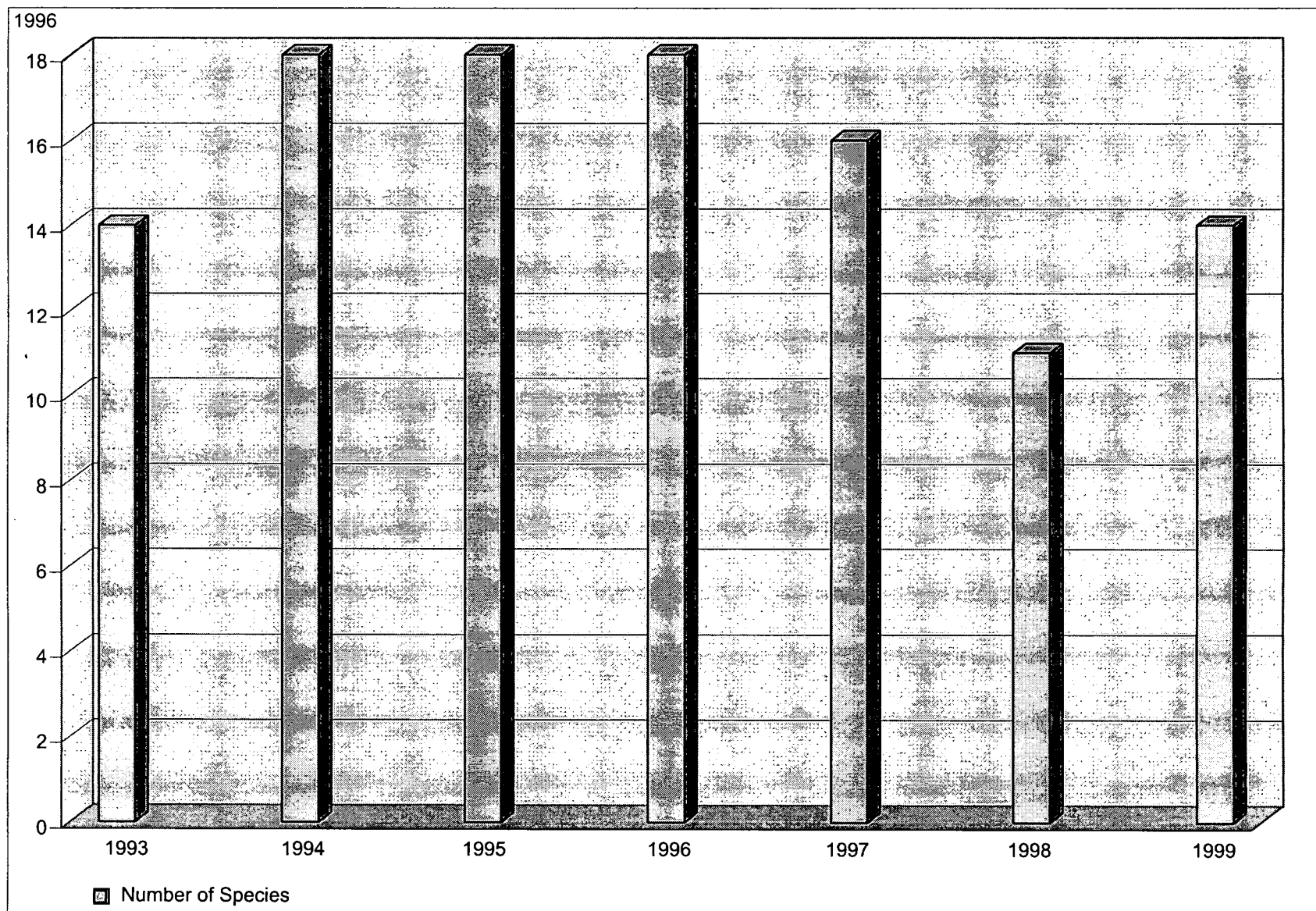
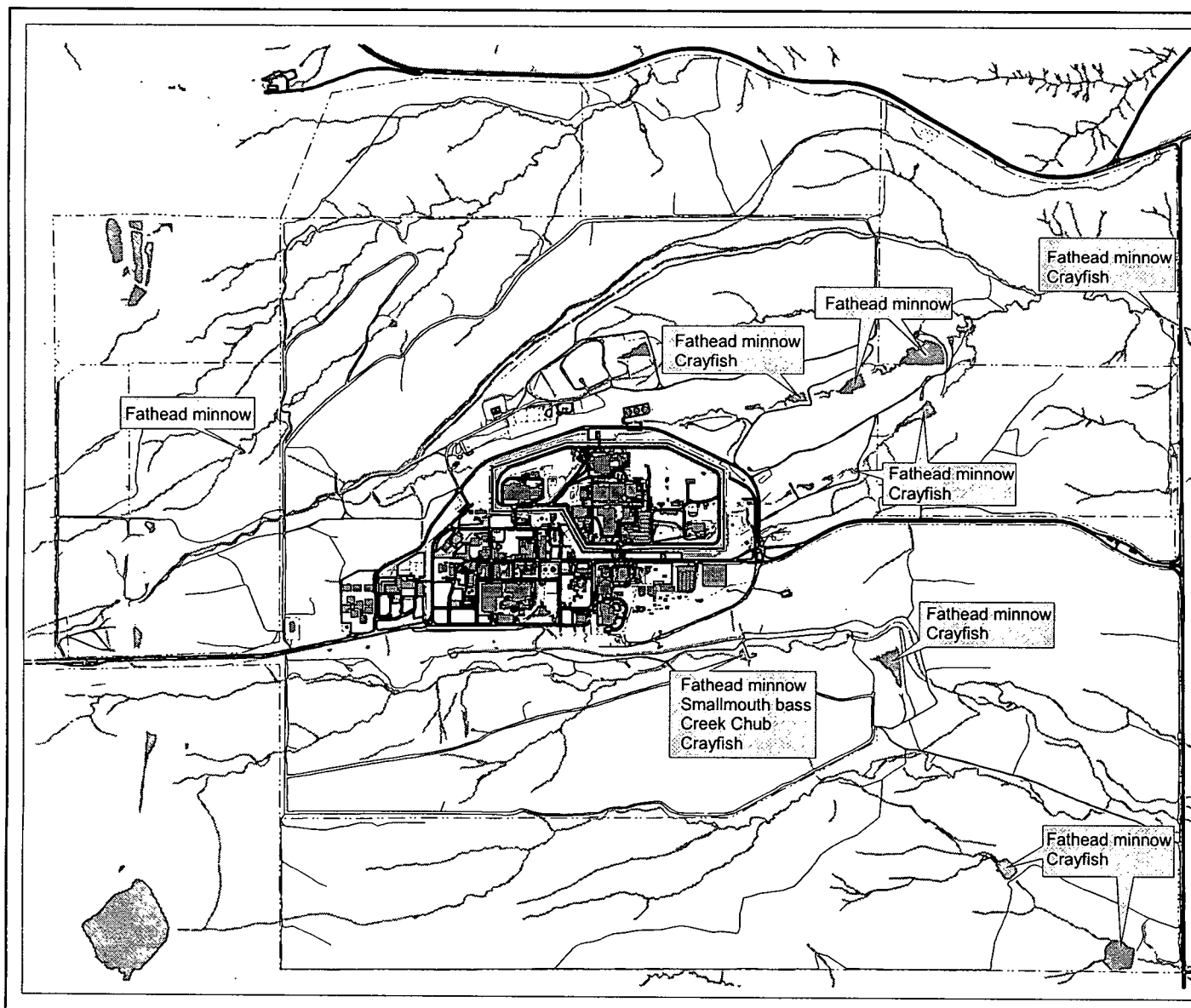


FIGURE 3-10. COMPARISON OF RAPTOR SPECIES NUMBERS RECORDED AT ROCKY FLATS ANUALLY (1993-1999)





Results of 1999 fish sampling.

Figure 3-11.

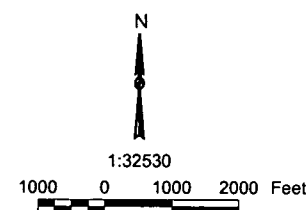
LEGEND

Ponds without labels indicate
no fish caught.

Standard Features

- Dirt roads
- Paved roads
- Streams & ditches
- Fences
- Contours (25 ft)
- Buildings & structures
- Lakes & ponds

DATA SOURCE:
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95
Hypsography derived from digital elevation model
(DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN
and LATTICE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Remote Sensing Lab,
Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution.
The DEM post-processing performed by MK, Winter 1997.



State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared
by:

For:

Exponent



Kaiser-Hill
Company, LLC

MAP ID: 2K-0208

April 20, 2000

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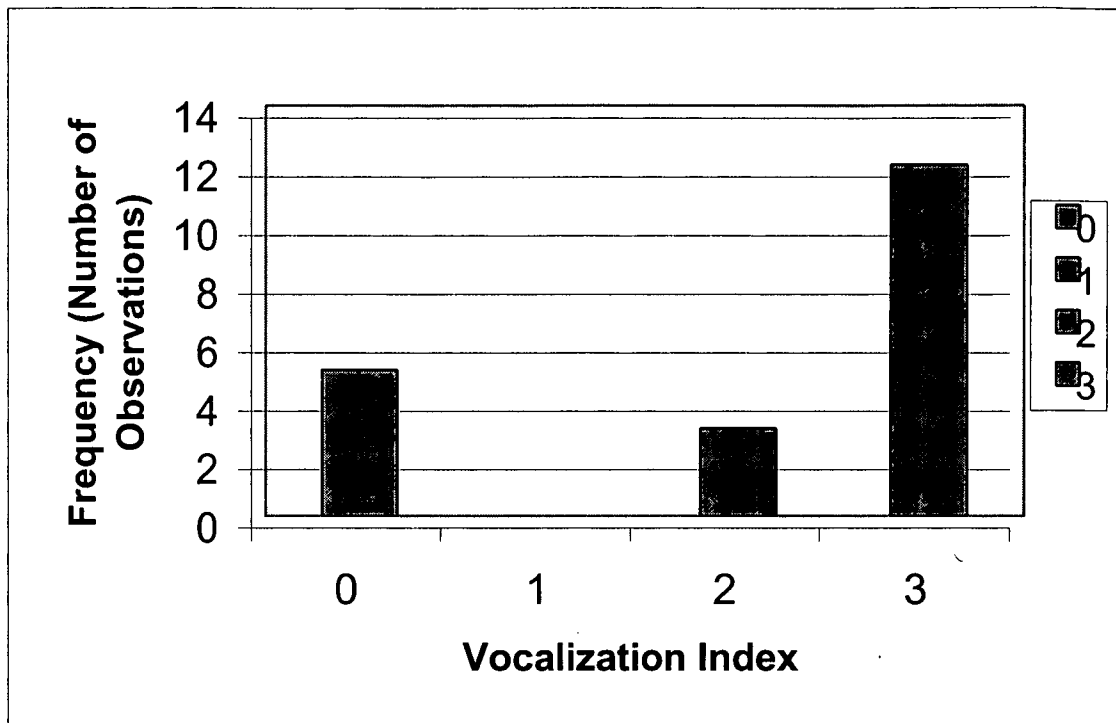


Figure 3-12. 1999 Boreal Chorus Frog Vocalization Index Data Summary

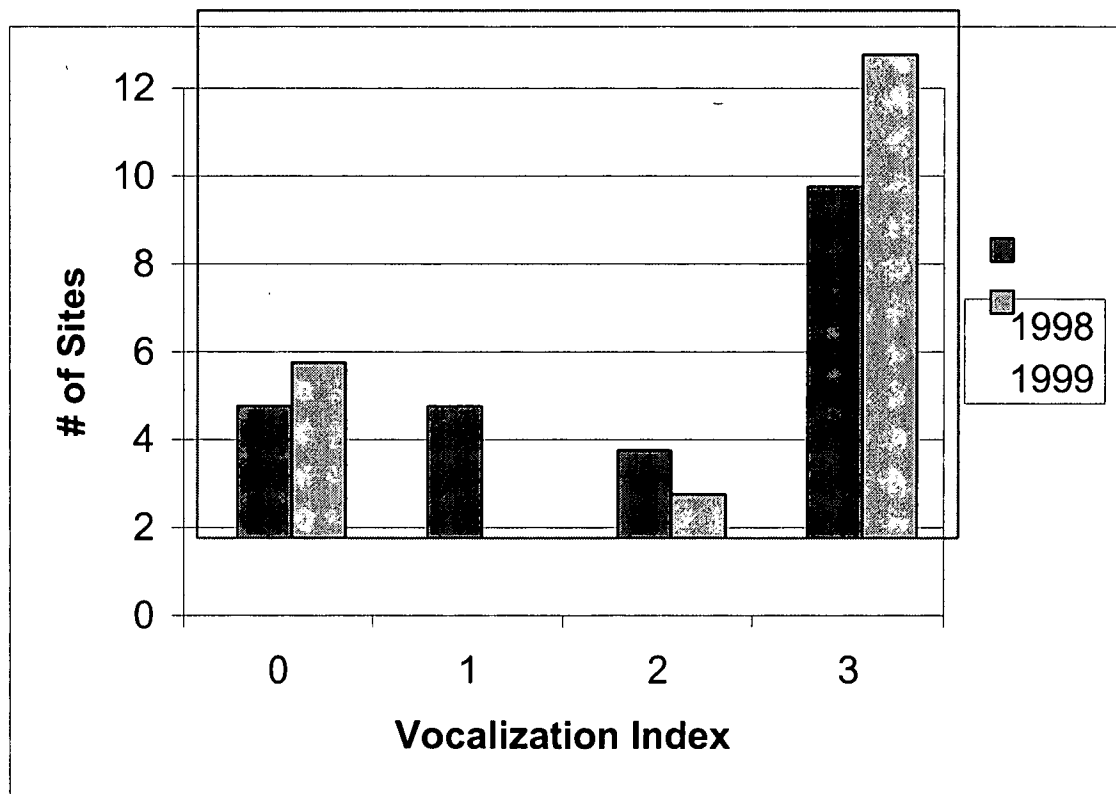


Figure 3-13. 1998 and 1999 Boreal Chorus Frog Vocalization Index Data Summary

1999 Boreal Chorus Frog Monitoring Locations and Results

Figure 3-14

MAP LEGEND

- § Boreal Chorus Frogs Present in 1999
- # Boreal Chorus Frogs Absent in 1999

Standard Map Features

- Buildings
- Lakes & Ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft)

DATA SOURCE:
Boreal Chorus Frog Monitoring Locations
provided by Exponent.
Buildings, fences, hydrography, roads and other
structures from 1994 aerial flyover data
captured by EG&G RSL, Las Vegas.
Digitized from the orthophotograph, 1995
Hydrography derived from digital elevation model
(DEM) data by Morrison Knudsen (MK) using ESRI Arc TIN
and LA-TINCE to process the DEM data to create 5-foot contours.
The DEM data was captured by the Ramona Sensing Lab,
Las Vegas, NV, 1994 Aerial Flyover at ~10 meter resolution.
The DEM post-processing performed by MK, Winter 1997.

Note:
These locations are approximate.



1:23552
1000 0 1000 2000 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

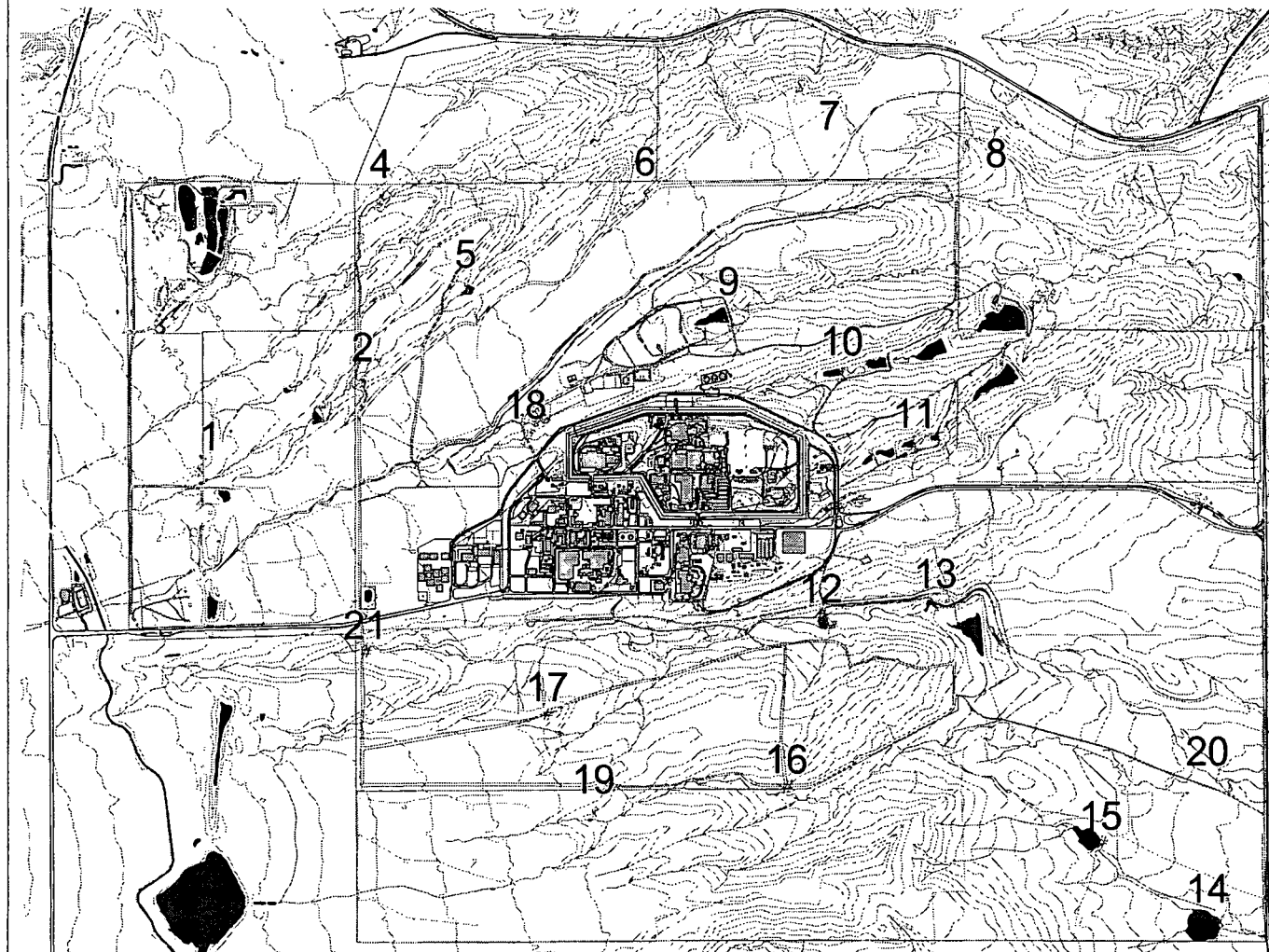
U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: [Empty Picture] For: [Empty Picture]
[Empty Picture] Company, LLC

MAP ID: K2-00116

January 17, 2000

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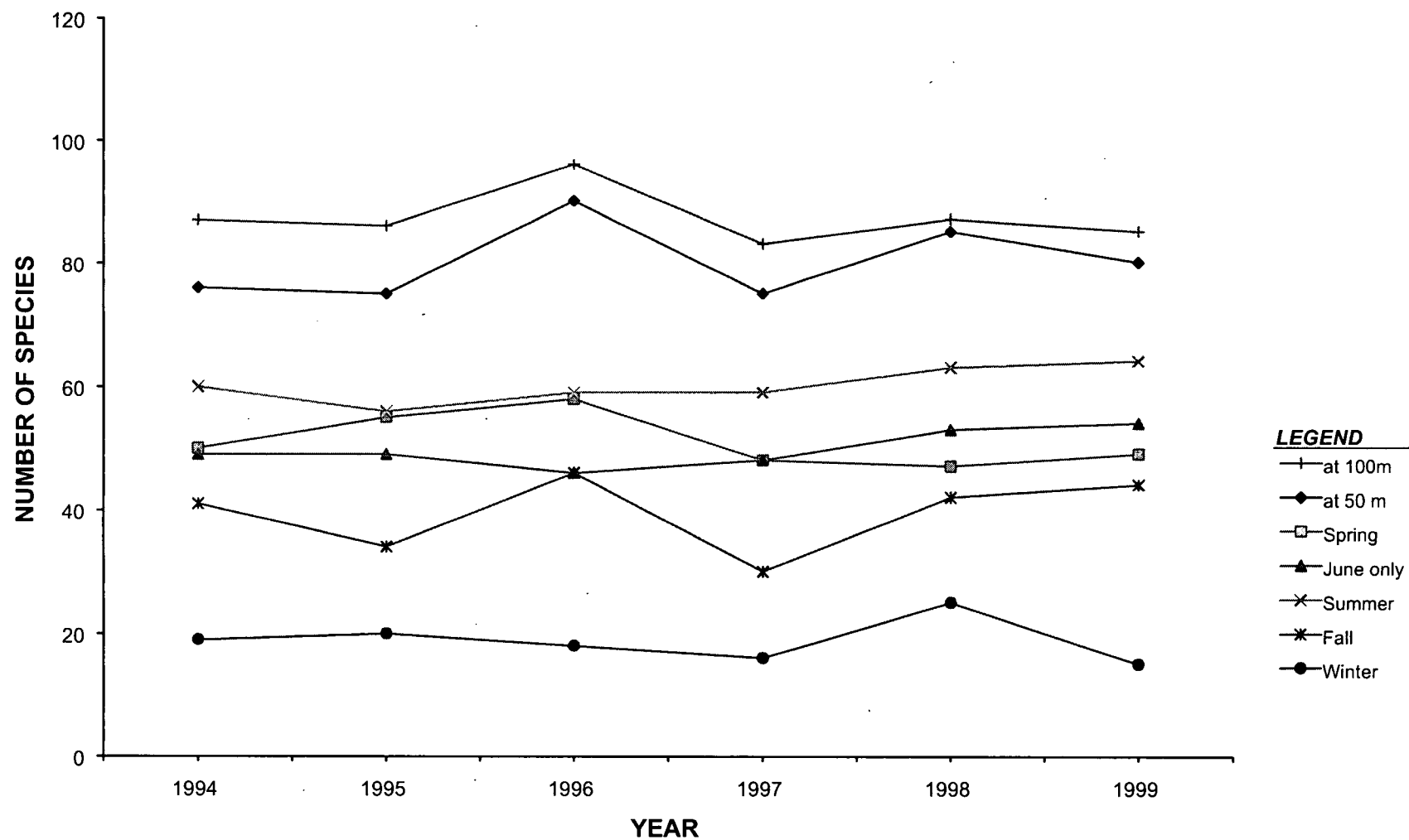


Figure 3-15. Species richness across all community types, 1994-1999.

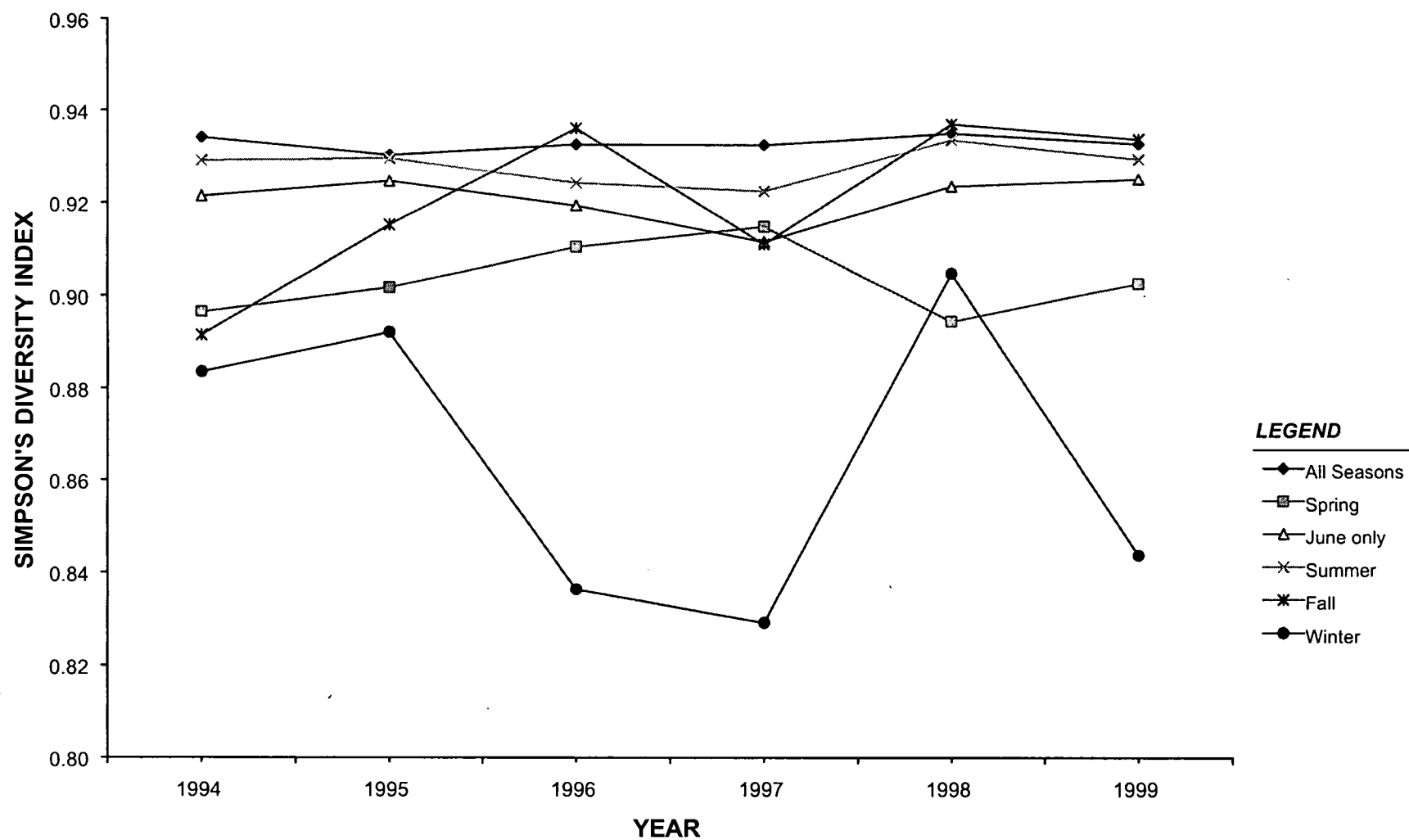


Figure 3-16. Bird diversity by season, 1994-1999.

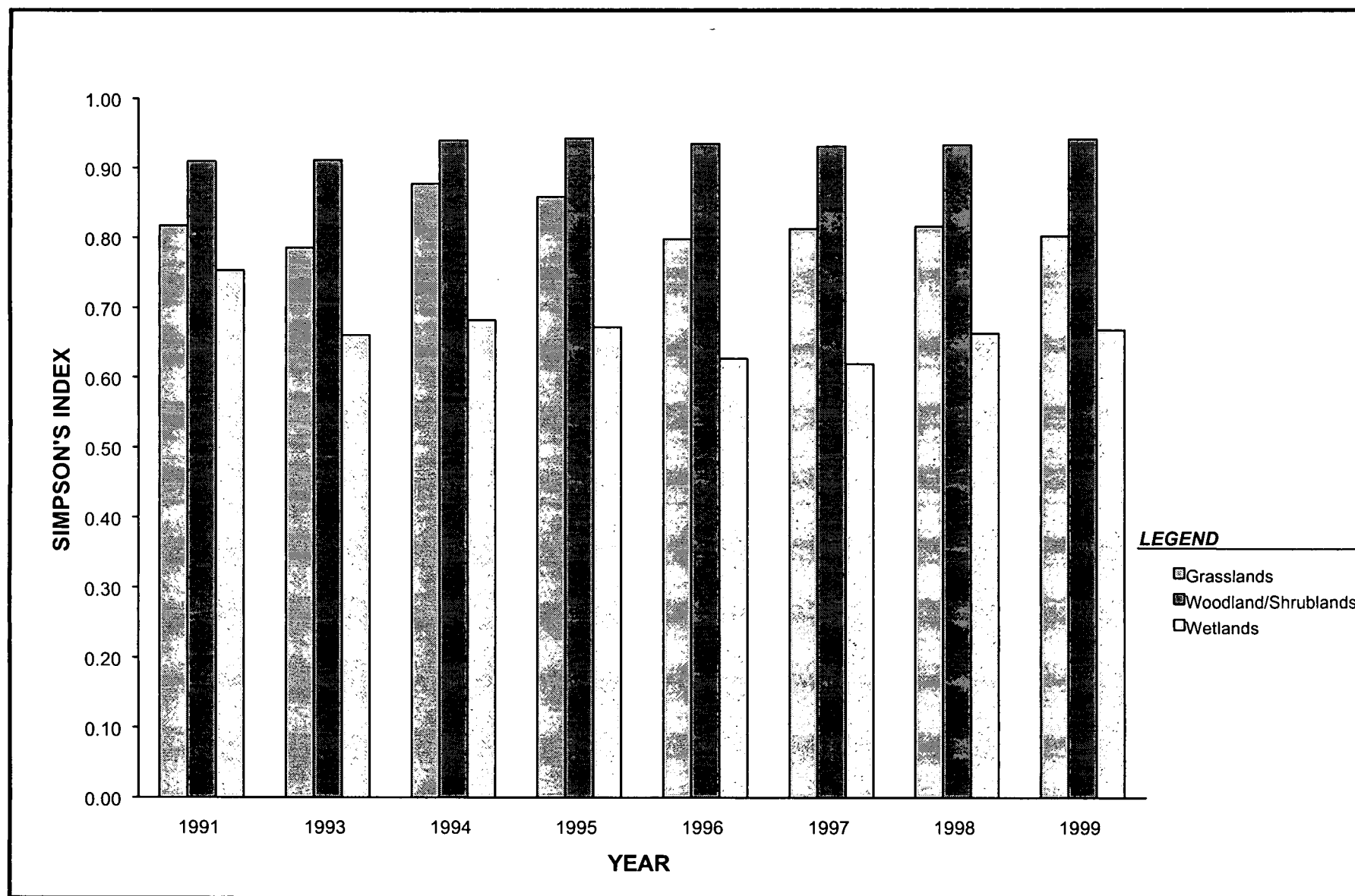


Figure 3-17. Diversity index by habitat for all years during June.

FIGURE 3-18. SPECIES RICHNESS OF BREEDING BIRDS BY HABITAT (1991, 1993-1999)

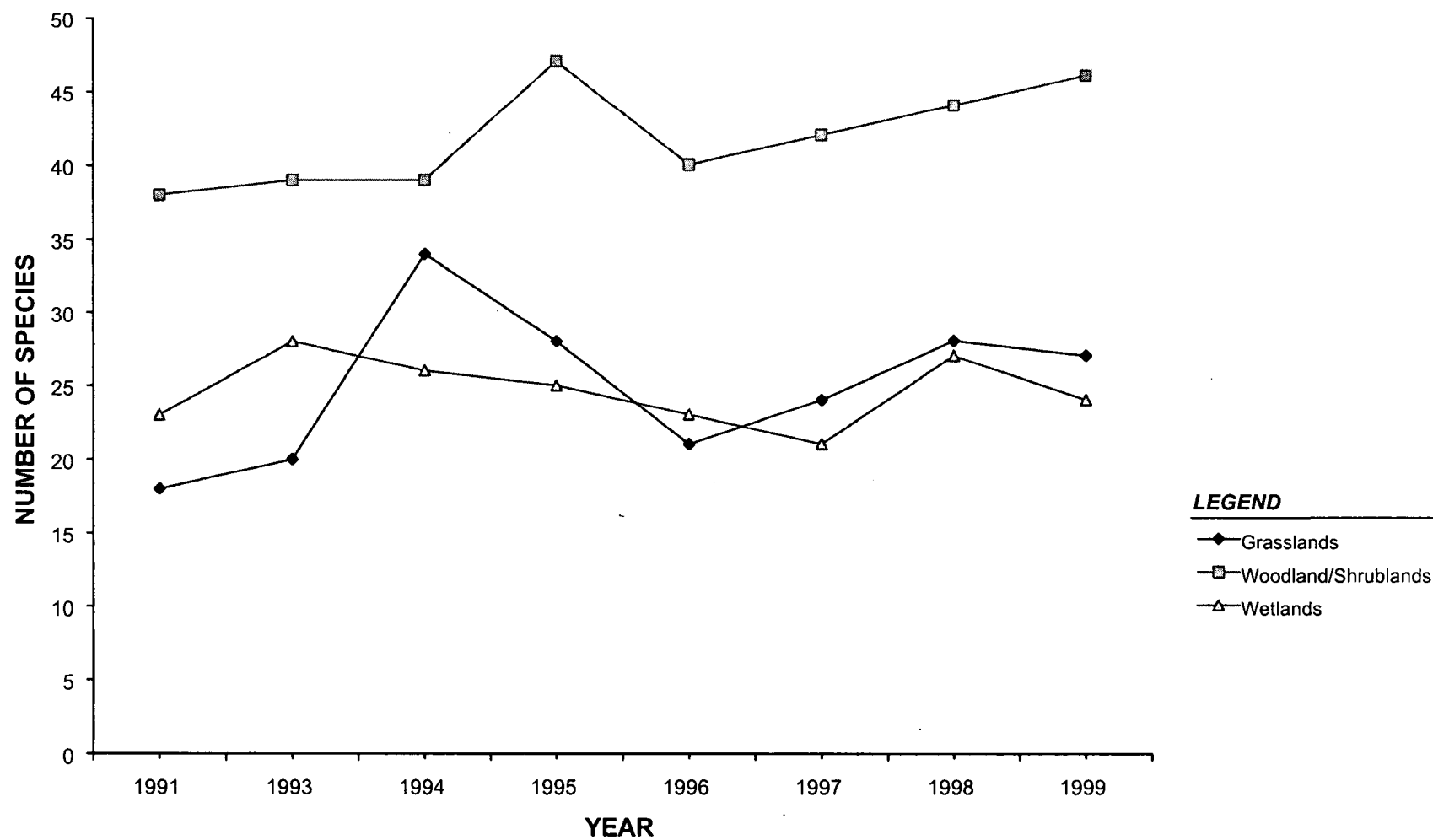


Figure 3-18. Species richness of breeding birds by habitat (1991, 1993-1999).

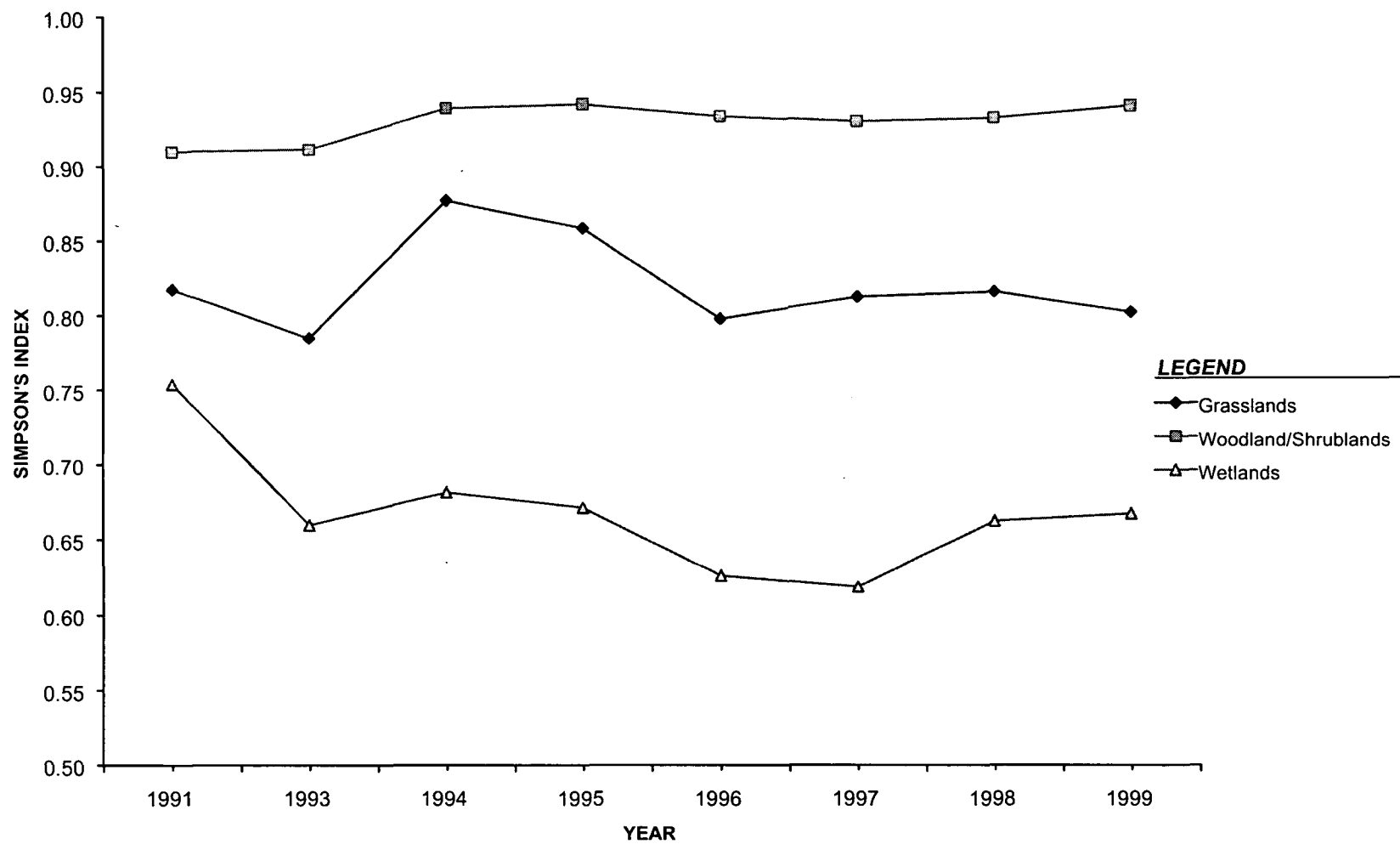


Figure 3-19. Diversity of breeding birds by habitat (1991, 1993-1999).

Table 3-1. Big game area use in 1999 based on sitewide significant species surveys

Season	RFGrid	Common Name	Spec Code	Number
Spring	3 J	Mule deer	ODHE1	17
	4 H	Mule deer	ODHE1	2
	4 I	Mule deer	ODHE1	15
	5 G	Mule deer	ODHE1	16
	5 K	Mule deer	ODHE1	22
	5 M	Mule deer	ODHE1	9
	6 I	Mule deer	ODHE1	8
	6 O	Mule deer	ODHE1	28
	7 G	Mule deer	ODHE1	2
	7 I	Mule deer	ODHE1	12
	8 O	Mule deer	ODHE1	3
	9 E	Mule deer	ODHE1	4
	9 F	Mule deer	ODHE1	9
	10 G	Mule deer	ODHE1	8
	11 I	Mule deer	ODHE1	7
	11 S	Mule deer	ODHE1	11
	12 F	Mule deer	ODHE1	4
	12 G	Mule deer	ODHE1	10
	12 I	Mule deer	ODHE1	10
	13 F	Mule deer	ODHE1	9
	13 G	Mule deer	ODHE1	5
	13 H	Mule deer	ODHE1	8
	13 I	Mule deer	ODHE1	6
	13 J	Mule deer	ODHE1	21
	14 F	Mule deer	ODHE1	11
	14 G	Mule deer	ODHE1	1
	14 K	Mule deer	ODHE1	16
	14 L	Mule deer	ODHE1	10
	15 G	Mule deer	ODHE1	3
	15 J	Mule deer	ODHE1	2
	15 L	Mule deer	ODHE1	14
	4 R	White-tailed deer	ODVI1	3
	11 S	White-tailed deer	ODVI1	1
	14 L	White-tailed deer	ODVI1	1
	15 H	White-tailed deer	ODVI1	1
	15 L	White-tailed deer	ODVI1	1
Summer	2 H	Mule deer	ODHE1	1
	2 K	Mule deer	ODHE1	2
	2 L	Mule deer	ODHE1	2
	2 P	Mule deer	ODHE1	1
	2 Q	Mule deer	ODHE1	3
	4 L	Mule deer	ODHE1	2
	4 O	Mule deer	ODHE1	3
	5 I	Mule deer	ODHE1	1
	5 O	Mule deer	ODHE1	2

Table 3-1. (cont.)

Season	RFGrid	Common Name	Spec Code	Number
Summer (cont.)	6 I	Mule deer	ODHE1	2
	6 J	Mule deer	ODHE1	1
	6 N	Mule deer	ODHE1	9
	6 R	Mule deer	ODHE1	2
	7 F	Mule deer	ODHE1	5
	7 G	Mule deer	ODHE1	3
	7 H	Mule deer	ODHE1	1
	7 I	Mule deer	ODHE1	1
	7 J	Mule deer	ODHE1	1
	8 L	Mule deer	ODHE1	1
	8 O	Mule deer	ODHE1	1
	9 O	Mule deer	ODHE1	3
	10 H	Mule deer	ODHE1	2
	11 E	Mule deer	ODHE1	1
	11 F	Mule deer	ODHE1	1
	12 E	Mule deer	ODHE1	2
	12 K	Mule deer	ODHE1	2
	12 L	Mule deer	ODHE1	1
	12 Q	Mule deer	ODHE1	2
	13 F	Mule deer	ODHE1	6
	13 G	Mule deer	ODHE1	1
	13 H	Mule deer	ODHE1	2
	13 K	Mule deer	ODHE1	2
	13 P	Mule deer	ODHE1	5
	14 F	Mule deer	ODHE1	2
	14 G	Mule deer	ODHE1	5
	14 H	Mule deer	ODHE1	3
	14 I	Mule deer	ODHE1	1
	14 J	Mule deer	ODHE1	5
	15 H	Mule deer	ODHE1	3
	15 K	Mule deer	ODHE1	1
	15 O	Mule deer	ODHE1	3
	16 L	Mule deer	ODHE1	3
	17 M	Mule deer	ODHE1	1
	13 H	White-tailed deer	ODVI1	2
Fall	5 O	Mule deer	ODHE1	3
	5 P	Mule deer	ODHE1	6
	5 Q	Mule deer	ODHE1	1
	6 H	Mule deer	ODHE1	14
	6 I	Mule deer	ODHE1	3
	6 K	Mule deer	ODHE1	3
	7 G	Mule deer	ODHE1	2
	7 H	Mule deer	ODHE1	2
	7 I	Mule deer	ODHE1	1
	7 J	Mule deer	ODHE1	12
	7 K	Mule deer	ODHE1	8
	7 L	Mule deer	ODHE1	2
	7 O	Mule deer	ODHE1	3

Table 3-1. (cont.)

Season	RFGid	Common Name	Spec Code	Number
Fall (cont.)	8 D	Mule deer	ODHE1	1
	10 F	Mule deer	ODHE1	2
	10 O	Mule deer	ODHE1	1
	11 E	Mule deer	ODHE1	5
	11 O	Mule deer	ODHE1	5
	11 R	Mule deer	ODHE1	2
	11 S	Mule deer	ODHE1	1
	12 E	Mule deer	ODHE1	19
	12 F	Mule deer	ODHE1	3
	12 O	Mule deer	ODHE1	3
	12 P	Mule deer	ODHE1	10
	12 S	Mule deer	ODHE1	1
	13 K	Mule deer	ODHE1	3
	13 N	Mule deer	ODHE1	6
	13 O	Mule deer	ODHE1	9
	14 E	Mule deer	ODHE1	5
	14 F	Mule deer	ODHE1	4
	14 G	Mule deer	ODHE1	3
	14 J	Mule deer	ODHE1	6
	15 F	Mule deer	ODHE1	5
	15 G	Mule deer	ODHE1	2
	15 H	Mule deer	ODHE1	8
	15 J	Mule deer	ODHE1	11
	15 K	Mule deer	ODHE1	1
	15 N	Mule deer	ODHE1	1
	15 R	Mule deer	ODHE1	1
	16 H	Mule deer	ODHE1	2
	12 P	White-tailed deer	ODVI1	1
	15 J	White-tailed deer	ODVI1	1
	2 O	White-tailed deer	ODVI1	6
Winter	2 L	Mule deer	ODHE1	6
	4 K	Mule deer	ODHE1	22
	4 N	Mule deer	ODHE1	1
	5 K	Mule deer	ODHE1	9
	5 L	Mule deer	ODHE1	10
	5 N	Mule deer	ODHE1	2
	7 I	Mule deer	ODHE1	2
	7 G	Mule deer	ODHE1	5
	7 I	Mule deer	ODHE1	5
	7 J	Mule deer	ODHE1	14
	7 K	Mule deer	ODHE1	6
	7 P	Mule deer	ODHE1	3
	7 Q	Mule deer	ODHE1	9
	7 R	Mule deer	ODHE1	1
	7 T	Mule deer	ODHE1	13
	8 L	Mule deer	ODHE1	9
	8 N	Mule deer	ODHE1	5
	8 Q	Mule deer	ODHE1	3

Table 3-1. (cont.)

Season	RFGrid	Common Name	Spec Code	Number
Winter (cont.)	9 E	Mule deer	ODHE1	4
	9 N	Mule deer	ODHE1	10
	10 G	Mule deer	ODHE1	12
	10 O	Mule deer	ODHE1	6
	11 G	Mule deer	ODHE1	19
	11 L	Mule deer	ODHE1	13
	12 J	Mule deer	ODHE1	13
	12 M	Mule deer	ODHE1	4
	12 O	Mule deer	ODHE1	28
	12 T	Mule deer	ODHE1	13
	13 F	Mule deer	ODHE1	2
	13 K	Mule deer	ODHE1	16
	14 P	Mule deer	ODHE1	2
	14 S	Mule deer	ODHE1	28
	14 T	Mule deer	ODHE1	27
	15 O	Mule deer	ODHE1	19
	12 T	White-tailed deer	ODVI1	2
	14 T	White-tailed deer	ODVI1	1
	3 O	White-tailed deer	ODVI1	7
	7 T	White-tailed deer	ODVI1	4
	8 Q	White-tailed deer	ODVI1	2

Table 3-2. Overall annual relative abundance of species based on multi-species census surveys

Taxonomic Group	Common Name	Spec Code	Total Number	Annual Relative Abundance (o/m)
			Obs	
Big Game	Mule deer	ODHE1	605	0.1151
	White-tailed deer	ODVI1	15	0.0029
Carnivore	Coyote	CALA1	48	0.0091
Herptiles	Boreal Chorus Frog	PSTR1	145	0.0276
	Western Painted Turtle	CHPI1	130	0.0247
	Northern Leopard Frog	RAPI1	14	0.0027
	Short-horned lizard	PHDO1	11	0.0021
	Bullfrog	RACA1	7	0.0013
	Snapping Turtle	CHSE1	1	0.0002
Raptors	Great Horned Owl	BUVI1	49	0.0093
	American Kestrel	FASP1	39	0.0074
	Red-tailed Hawk	BUJA1	25	0.0048
	Northern Harrier	CICY1	14	0.0027
	Swainson's Hawk	BUSW1	8	0.0015
	Rough-legged Hawk	BULA1	4	0.0008
	Sharp-shinned Hawk	ACST1	4	0.0008
	Golden Eagle	AQCH1	2	0.0004
	Prairie Falcon	FAME1	2	0.0004
	Turkey Vulture	CAAU1	2	0.0004
	Ferruginous Hawk	BURE1	1	0.0002
Migratory Birds	Red-winged Blackbird	AGPH1	901	0.1714
	Western Meadowlark	STNE1	586	0.1114
	Vesper Sparrow	POGR1	488	0.0928
	House Finch	CAME2	486	0.0924
	European Starling	STVU1	279	0.0531
	Barn Swallow	HIRU1	244	0.0464
	Black-billed Magpie	PIPI1	235	0.0447
	Song Sparrow	MEME2	207	0.0394
	American Goldfinch	CATR1	183	0.0348
	Mourning Dove	ZEMA1	182	0.0346
	Rufous-sided Towhee	PIER1	115	0.0219
	American Robin	TUMI1	112	0.0213
	Northern Oriole	ICGA1	106	0.0202
	Common Yellowthroat	GETR1	84	0.0160
	Cliff Swallow	HIPY1	81	0.0154
	Yellow-headed Blackbird	XAXA1	77	0.0146
	American Tree Sparrow	SPAR1	65	0.0124
	Brown-headed Cowbird	MOAT1	62	0.0118
	Yellow Warbler	DEPE1	55	0.0105
	Northern Flicker	COAU1	53	0.0101
	White-crowned Sparrow	ZOLE1	49	0.0093

Table 3-2. (cont.)

Taxonomic Group	Common Name	Spec Code	Total Number	Annal Relative Abundance
			Obs	(o/m)
Migratory Birds (cont.)	Black-capped Chickadee	PAAT1	45	0.0086
	Grasshopper Sparrow	AMSA1	44	0.0084
	Western Kingbird	TYVE1	39	0.0074
	Brewer's Blackbird	EUCY1	34	0.0065
	Horned Lark	ERAL1	33	0.0063
	Blue Grosbeak	GUCA1	32	0.0061
	Say's Phoebe	SASA1	31	0.0059
	Yellow-rumped Warbler	DECO1	24	0.0046
	House Wren	TRAE1	18	0.0034
	Mountain Bluebird	SICU1	18	0.0034
	Rock Wren	SAOB1	18	0.0034
	Eastern Phoebe	SAPH1	16	0.0030
	Green-tailed Towhee	PICH1	15	0.0029
	Lesser Goldfinch	CAPS1	12	0.0023
	Yellow-breasted Chat	ICV11	12	0.0023
	Chipping Sparrow	SPPA1	10	0.0019
	Blue-gray Gnatcatcher	POCA2	7	0.0013
	Virginia's Warbler	VEV11	7	0.0013
	Brewer's Sparrow	SPBR1	5	0.0010
	Common Grackle	QUQU1	5	0.0010
	Eastern Kingbird	TYTY1	5	0.0010
	Sage Thrasher	ORMO1	5	0.0010
	Loggerhead Shrike	LALU1	4	0.0008
	Orange-crowned warbler	VECE1	4	0.0008
	Rock Dove	COLI1	4	0.0008
	Belted Kingfisher	CEAL1	3	0.0006
	Broad-tailed Hummingbird	SEPL1	3	0.0006
	Common Raven	COCO1	3	0.0006
	Marsh Wren	CIPA1	3	0.0006
	Violet-green Swallow	TATH1	3	0.0006
	Western Wood-Pewee	COSO1	3	0.0006
	American redstart	SERU2	2	0.0004
	Common Nighthawk	CHMI1	2	0.0004
	Downy Woodpecker	PIPU1	2	0.0004
	Pine Siskin	CAPI1	2	0.0004
	Ash-throated Flycatcher	MYCI1	1	0.0002
	Black-headed Grosbeak	PHME1	1	0.0002
	Blue Jay	CYCR1	1	0.0002
	Dark-eyed Junco	JUHY1	1	0.0002
	Gray Catbird	DUCA1	1	0.0002
	Hairy Woodpecker	PIVI1	1	0.0002
	Northern mockingbird	MIPO1	1	0.0002
	Red-breasted Nuthatch	SICA2	1	0.0002
	Wilson's Warbler	WIPU1	1	0.0002

Table 3-2. (cont.)

Taxonomic Group	Common Name	Spec Code	Total Number Obs	Annal Relative Abundance (o/m)
Waterfowl	Mallard	ANPL1	384	0.0730
	Canada Goose	BRCA1	123	0.0234
	American Coot	FUAM1	121	0.0230
	Blue-winged Teal	ANDI1	102	0.0194
	Ring-necked Duck	AYCO1	73	0.0139
	Bufflehead	BUAL1	60	0.0114
	Green-winged Teal	ANCR1	47	0.0089
	Pied-billed Grebe	POPO1	47	0.0089
	Double-crested Cormorant	PHAU1	38	0.0072
	Killdeer	CHVO1	37	0.0070
	Common Snipe	GAGA1	33	0.0063
	Gadwall	ANST1	26	0.0049
	Cinnamon Teal	ANCY1	13	0.0025
	Great Blue Heron	ARHE1	12	0.0023
	Redhead	AYAM1	9	0.0017
	American White Pelican	PEER1	7	0.0013
	Black-crowned Night-heron	NYNY1	6	0.0011
	White-faced Ibis	PLCH1	6	0.0011
	American Wigeon	ANAM1	5	0.0010
	Spotted Sandpiper	ACMA1	5	0.0010
	Common Goldeneye	BUCL1	4	0.0008
	Lesser Scaup	AYAF1	3	0.0006
	Northern Shoveler	ANCL1	3	0.0006
	Lesser Yellowlegs	TRFL1	2	0.0004
	Solitary Sandpiper	TRSO1	2	0.0004
	Sora	POCA1	2	0.0004
	Eared grebe	PONI1	1	0.0002
	Franklin's Gull	LAPI1	1	0.0002
	Great egret	CAAL1	1	0.0002
	Ring-billed Gull	LADE1	1	0.0002
	Ruddy Duck	OXJA1	1	0.0002
	Wood duck	AISP1	1	0.0002
Lagomorphs and Large Rodents	Desert cottontail	SYAU1	14	0.0027
	Muskrat	ONZI1	7	0.0013
	Common porcupine	ERDO1	1	0.0002
	Eastern fox squirrel	SCNI1	1	0.0002
	unidentified jackrabbit	LEP1	1	0.0002

Table 3-3. Big game relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	10	Mule deer	ODHE1	3	37	0.08	2.83	106	1302	0.081
	20	Mule deer	ODHE1	10	104	0.10	9.43	106	1302	0.081
	110	Mule deer	ODHE1	33	301	0.11	31.13	106	1302	0.081
	230	Mule deer	ODHE1	15	147	0.10	14.15	106	1302	0.081
	322	Mule deer	ODHE1	8	181	0.04	7.55	106	1302	0.081
	323	Mule deer	ODHE1	28	139	0.20	26.42	106	1302	0.081
	324	Mule deer	ODHE1	9	25	0.36	8.49	106	1302	0.081
Summer	10	Mule deer	ODHE1	6	59	0.10	5.66	106	1547	0.069
	20	Mule deer	ODHE1	14	98	0.14	13.21	106	1547	0.069
	110	Mule deer	ODHE1	35	411	0.09	33.02	106	1547	0.069
	212	Mule deer	ODHE1	10	124	0.08	9.43	106	1547	0.069
	230	Mule deer	ODHE1	25	202	0.12	23.58	106	1547	0.069
	322	Mule deer	ODHE1	5	159	0.03	4.72	106	1547	0.069
	323	Mule deer	ODHE1	10	159	0.06	9.43	106	1547	0.069
	324	Mule deer	ODHE1	1	23	0.04	0.94	106	1547	0.069
	30	White-tailed deer	ODVI1	4	109	0.04	50.00	8	1547	0.005
	212	White-tailed deer	ODVI1	2	124	0.02	25.00	8	1547	0.005
	230	White-tailed deer	ODVI1	2	202	0.01	25.00	8	1547	0.005
Fall	10	Mule deer	ODHE1	4	45	0.09	3.03	132	1356	0.097
	20	Mule deer	ODHE1	24	87	0.28	18.18	132	1356	0.097
	30	Mule deer	ODHE1	8	125	0.06	6.06	132	1356	0.097
	110	Mule deer	ODHE1	26	323	0.08	19.70	132	1356	0.097
	212	Mule deer	ODHE1	10	164	0.06	7.58	132	1356	0.097
	230	Mule deer	ODHE1	26	186	0.14	19.70	132	1356	0.097
	322	Mule deer	ODHE1	23	133	0.17	17.42	132	1356	0.097
	323	Mule deer	ODHE1	11	129	0.09	8.33	132	1356	0.097
	110	White-tailed deer	ODVI1	5	323	0.02	71.43	7	1356	0.005
	322	White-tailed deer	ODVI1	2	133	0.02	28.57	7	1356	0.005

Table 3-3. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Winter	20	Mule deer	ODHE1	14	93	0.15	5.36	261	1053	0.248
	110	Mule deer	ODHE1	30	263	0.11	11.49	261	1053	0.248
	212	Mule deer	ODHE1	26	63	0.41	9.96	261	1053	0.248
	230	Mule deer	ODHE1	16	136	0.12	6.13	261	1053	0.248
	322	Mule deer	ODHE1	142	152	0.93	54.41	261	1053	0.248
	323	Mule deer	ODHE1	24	127	0.19	9.20	261	1053	0.248
	324	Mule deer	ODHE1	9	16	0.56	3.45	261	1053	0.248

**Table 3-4. Lagomorph and large rodent area use in 1999
based on sitewide significant species surveys**

Season	RFGid	Common Name	Spec Code	Number
Spring	2 N	White-tailed jackrabbit	LETO1	1
	2 O	Black-tailed prairie dog	CYLU1	1
Summer	10 H	Desert cottontail	SYAU1	1
	10 Q	Desert cottontail	SYAU1	4
	11 J	Desert cottontail	SYAU1	1
	13 K	Desert cottontail	SYAU1	1
	15 N	Desert cottontail	SYAU1	2
	15 P	Desert cottontail	SYAU1	1
	2 N	Black-tailed prairie dog	CYLU1	35
	2 O	Desert cottontail	SYAU1	1
Fall	2 O	Black-tailed prairie dog	CYLU1	45
	8 L	Desert cottontail	SYAU1	4
	13 L	Desert cottontail	SYAU1	1
Winter	2 N	Black-tailed prairie dog	CYLU1	4
	2 O	Black-tailed prairie dog	CYLU1	6
	13 G	Common porcupine	ERDO1	1

Table 3-5. Lagomorph and large rodent relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	420	Desert cottontail	SYAU1	4	6	0.67	50.00	8	1302	0.006
	530	Desert cottontail	SYAU1	2	1	2.00	25.00	8	1302	0.006
	540	Desert cottontail	SYAU1	2	2	1.00	25.00	8	1302	0.006
	54	Muskrat	ONZI1	2	112	0.02	100.00	2	1302	0.002
Summer	420	Desert cottontail	SYAU1	1	3	0.33	33.33	3	1547	0.002
	540	Desert cottontail	SYAU1	2	5	0.40	66.67	3	1547	0.002
Fall	322	Desert cottontail	SYAU1	1	133	0.01	50.00	2	1356	0.001
	540	Desert cottontail	SYAU1	1	11	0.09	50.00	2	1356	0.001
	110	Eastern fox squirrel	SCNI1	1	323	0.00	100.00	1	1356	0.001
	54	Muskrat	ONZI1	4	113	0.04	100.00	4	1356	0.003
Winter	110	Common porcupine	ERDO1	1	263	0.00	100.00	1	1053	0.001
	540	Desert cottontail	SYAU1	1	5	0.20	100.00	1	1053	0.001
	54	Muskrat	ONZI1	1	61	0.02	100.00	1	1053	0.001
	30	unidentified jackrabbit	LEP1	1	73	0.01	100.00	1	1053	0.001

Table 3-6. Carnivore area use in 1999 based on sitewide significant species surveys

Season	RFGid	Common Name	Spec Code	Number
Spring	2 L	Coyote	CALA1	2
	2 Q	Coyote	CALA1	1
	2 T	Coyote	CALA1	4
	3 K	Coyote	CALA1	1
Summer	11 E	Coyote	CALA1	1
	11 O	Coyote	CALA1	1
	12 F	Coyote	CALA1	1
	13 J	Coyote	CALA1	3
	15 F	Coyote	CALA1	1
	16 G	Coyote	CALA1	1
	11 P	Raccoon	PRLO1	6
Fall	2 M	Coyote	CALA1	3
	2 O	Coyote	CALA1	1
	4 I	Coyote	CALA1	1
	11 R	Coyote	CALA1	2
	11 S	Coyote	CALA1	1
	14 G	Coyote	CALA1	1
	15 J	Coyote	CALA1	1
Winter	2 O	Coyote	CALA1	1
	2 S	Coyote	CALA1	1
	3 S	Coyote	CALA1	2
	4 G	Coyote	CALA1	1
	4 O	Coyote	CALA1	1
	12 F	Coyote	CALA1	1
	13 F	Coyote	CALA1	1
	14 F	Coyote	CALA1	1
	15 J	Coyote	CALA1	1
	16 L	Coyote	CALA1	1

Table 3-7. Carnivore relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	20	Coyote	CALA1	2	104	0.02	13.33	15	1302	0.012
	30	Coyote	CALA1	1	107	0.01	6.67	15	1302	0.012
	110	Coyote	CALA1	1	301	0.00	6.67	15	1302	0.012
	322	Coyote	CALA1	10	181	0.06	66.67	15	1302	0.012
	323	Coyote	CALA1	1	139	0.01	6.67	15	1302	0.012
Summer	10	Coyote	CALA1	4	59	0.07	36.36	11	1547	0.007
	30	Coyote	CALA1	3	109	0.03	27.27	11	1547	0.007
	110	Coyote	CALA1	1	411	0.00	9.09	11	1547	0.007
	230	Coyote	CALA1	3	202	0.01	27.27	11	1547	0.007
Fall	20	Coyote	CALA1	1	87	0.01	16.67	6	1356	0.004
	30	Coyote	CALA1	1	125	0.01	16.67	6	1356	0.004
	110	Coyote	CALA1	2	323	0.01	33.33	6	1356	0.004
	230	Coyote	CALA1	2	186	0.01	33.33	6	1356	0.004
Winter	20	Coyote	CALA1	3	93	0.03	18.75	16	1053	0.015
	30	Coyote	CALA1	5	73	0.07	31.25	16	1053	0.015
	211	Coyote	CALA1	2	28	0.07	12.50	16	1053	0.015
	230	Coyote	CALA1	3	136	0.02	18.75	16	1053	0.015
	322	Coyote	CALA1	3	152	0.02	18.75	16	1053	0.015

Table 3-8. Waterfowl area use in 1999 based on sitewide significant species surveys

Season	RFGid	Common Name	Spec Code	Number
Spring	2 T	Blue-winged Teal	ANDI1	2
	2 T	Bufflehead	BUAL1	3
	2 T	Gadwall	ANST1	6
	2 T	Green-winged Teal	ANCR1	2
	2 T	Pied-billed Grebe	POPO1	6
	2 T	Ring-necked Duck	AYCO1	24
	2 U	American Coot	FUAM1	31
	2 U	Bufflehead	BUAL1	1
	2 U	Canada Goose	BRCA1	1
	2 U	Cinnamon Teal	ANCY1	2
	2 U	Mallard	ANPL1	6
	3 R	Gadwall	ANST1	10
	3 R	Lesser Scaup	AYAF1	1
	3 R	Mallard	ANPL1	2
	3 R	Ring-necked Duck	AYCO1	2
	4 R	Bufflehead	BUAL1	2
	4 R	Green-winged Teal	ANCR1	8
	4 R	Pied-billed Grebe	POPO1	1
	4 R	Redhead	AYAM1	6
	4 R	Ring-necked Duck	AYCO1	12
	4 S	American Coot	FUAM1	2
	7 N	Cinnamon Teal	ANCY1	2
	7 N	Gadwall	ANST1	2
	7 N	Pied-billed Grebe	POPO1	1
	7 P	Bufflehead	BUAL1	5
	7 P	Canada Goose	BRCA1	6
	7 P	Gadwall	ANST1	4
	7 P	Green-winged Teal	ANCR1	6
	7 P	Mallard	ANPL1	1
	7 P	Pied-billed Grebe	POPO1	2
	7 P	Ring-necked Duck	AYCO1	1
	7 U	Great Blue Heron	ARHE1	1
	9 E	Mallard	ANPL1	2
	10 O	American Coot	FUAM1	1
	10 O	Canada Goose	BRCA1	2
	10 O	Cinnamon Teal	ANCY1	5
	10 O	Gadwall	ANST1	3
	10 O	Mallard	ANPL1	7
	10 P	Mallard	ANPL1	4
	11 P	Mallard	ANPL1	1
	11 Q	Gadwall	ANST1	2
	11 Q	Great Blue Heron	ARHE1	2
	11 Q	Mallard	ANPL1	2
	12 L	Mallard	ANPL1	5
	12 L	Ring-necked Duck	AYCO1	4
	12 O	Mallard	ANPL1	4
	12 O	Ring-necked Duck	AYCO1	4

Table 3-8. (cont.)

Season	RFGid	Common Name	Spec Code	Number
Spring (cont.)	12 P	Blue-winged Teal	ANDI1	4
	12 P	Bufflehead	BUAL1	2
	12 P	Gadwall	ANST1	6
	12 P	Green-winged Teal	ANCR1	1
	12 P	Mallard	ANPL1	1
	12 P	Ring-necked Duck	AYCO1	13
	12 P	Wilson's Phalarope	PHTR1	6
	12 Q	Blue-winged Teal	ANDI1	2
	12 Q	Bufflehead	BUAL1	7
	12 Q	Canada Goose	BRCA1	4
	12 Q	Common Goldeneye	BUCL1	3
	12 Q	Double-crested Cormorant	PHAU1	5
	12 Q	Green-winged Teal	ANCR1	14
	12 Q	Mallard	ANPL1	9
	13 H	Green-winged Teal	ANCR1	1
	13 H	Mallard	ANPL1	1
	13 L	American Coot	FUAM1	1
	13 L	Gadwall	ANST1	8
	13 L	Mallard	ANPL1	6
	13 L	Pied-billed Grebe	POPO1	1
	13 Q	American White Pelican	PEER1	1
Summer	2 T	American Coot	FUAM1	36
	2 T	Double-crested Cormorant	PHAU1	4
	2 T	Mallard	ANPL1	4
	2 T	Ruddy Duck	OXJA1	1
	2 U	Gadwall	ANST1	2
	2 U	Great Blue Heron	ARHE1	1
	2 U	Mallard	ANPL1	7
	2 U	Pied-billed Grebe	POPO1	13
	3 R	Blue-winged Teal	ANDI1	1
	3 R	Pied-billed Grebe	POPO1	3
	3 S	Mallard	ANPL1	3
	4 R	American Coot	FUAM1	1
	4 R	Pied-billed Grebe	POPO1	1
	7 N	Mallard	ANPL1	1
	10 O	Blue-winged Teal	ANDI1	3
	10 O	Cinnamon Teal	ANCY1	4
	10 O	Gadwall	ANST1	2
	10 O	Mallard	ANPL1	6
	10 P	Mallard	ANPL1	2
	11 P	Great Blue Heron	ARHE1	1
	11 Q	Gadwall	ANST1	2
	11 Q	Mallard	ANPL1	4
	12 L	Blue-winged Teal	ANDI1	2
	12 L	Gadwall	ANST1	2
	12 L	Great Blue Heron	ARHE1	1
	12 L	Mallard	ANPL1	2
	12 O	Canada Goose	BRCA1	5

Table 3-8. (cont.)

Season	RFGGrid	Common Name	Spec Code	Number
Summer (cont.)	12 O	Double-crested Cormorant	PHAU1	1
	12 O	Gadwall	ANST1	3
	12 O	Mallard	ANPL1	8
	12 P	Great Blue Heron	ARHE1	1
	12 P	Mallard	ANPL1	2
	12 Q	Canada Goose	BRCA1	9
	12 Q	Double-crested Cormorant	PHAU1	9
	12 Q	Great Blue Heron	ARHE1	2
	12 Q	Mallard	ANPL1	5
	13 L	Mallard	ANPL1	1
Fall	2 T	American Coot	FUAM1	16
	2 T	Blue-winged Teal	ANDI1	2
	2 U	American Coot	FUAM1	27
	2 U	Bufflehead	BUAL1	4
	2 U	Common Goldeneye	BUCL1	1
	2 U	Gadwall	ANST1	6
	2 U	Pied-billed Grebe	POPO1	5
	2 U	Ring-necked Duck	AYCO1	8
	2 U	Ruddy Duck	OXJA1	2
	3 R	Ring-necked Duck	AYCO1	6
	3 S	Bufflehead	BUAL1	5
	4 R	American Coot	FUAM1	2
	4 R	Pied-billed Grebe	POPO1	3
	4 R	Ring-necked Duck	AYCO1	1
	4 S	American Coot	FUAM1	2
	7 N	Blue-winged Teal	ANDI1	1
	7 N	Mallard	ANPL1	1
	7 P	Blue-winged Teal	ANDI1	30
	7 P	Bufflehead	BUAL1	4
	7 P	Green-winged Teal	ANCR1	18
	7 P	Mallard	ANPL1	6
	10 O	Blue-winged Teal	ANDI1	1
	10 O	Mallard	ANPL1	24
	10 P	Blue-winged Teal	ANDI1	1
	10 P	Mallard	ANPL1	1
	12 O	Blue-winged Teal	ANDI1	1
	12 P	Bufflehead	BUAL1	2
	12 P	Mallard	ANPL1	7
	12 P	Pied-billed Grebe	POPO1	1
	12 Q	Mallard	ANPL1	3
	13 Q	Bufflehead	BUAL1	2
	13 Q	Double-crested Cormorant	PHAU1	1
Winter	2 T	Bufflehead	BUAL1	2
	2 T	Canada Goose	BRCA1	30
	2 T	Mallard	ANPL1	13
	2 T	Ring-necked Duck	AYCO1	10
	2 U	American Coot	FUAM1	2

Table 3-8. (cont.)

Season	RFGrid	Common Name	Spec Code	Number
Winter (cont.)	2 U	Pied-billed Grebe	POPO1	1
	3 R	Common Goldeneye	BUCL1	2
	3 R	Ring-necked Duck	AYCO1	4
	4 R	Mallard	ANPL1	3
	4 R	Redhead	AYAM1	3
	7 P	Common Goldeneye	BUCL1	2
	7 P	Mallard	ANPL1	2
	10 O	Mallard	ANPL1	2
	12 L	Canada Goose	BRCA1	2
	12 L	Mallard	ANPL1	4
	12 O	Mallard	ANPL1	2
	12 O	Redhead	AYAM1	1
	12 O	Ring-necked Duck	AYCO1	1
	12 Q	Green-winged Teal	ANCR1	10
	12 Q	Mallard	ANPL1	25
	12 Q	Northern Pintail	ANAC1	1
	12 Q	Redhead	AYAM1	1
	13 Q	Bufflehead	BUAL1	2
	13 Q	Common Goldeneye	BUCL1	2
	13 Q	Mallard	ANPL1	10

Table 3-9. Waterfowl relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/Min	Percent Obs/Season	Total Obs/Season	Time in Season	Obs/Min for Sp./Season
Spring	54	American Coot	FUAM1	28	112	0.25	100.00	28	1302	0.022
	54	American White Pelican	PEER1	7	112	0.06	100.00	7	1302	0.005
	30	Blue-winged Teal	ANDI1	4	107	0.04	8.51	47	1302	0.036
	54	Blue-winged Teal	ANDI1	43	112	0.38	91.49	47	1302	0.036
	54	Bufflehead	BUAL1	8	112	0.07	100.00	8	1302	0.006
	30	Canada Goose	BRCA1	4	107	0.04	25.00	16	1302	0.012
	54	Canada Goose	BRCA1	12	112	0.11	75.00	16	1302	0.012
	30	Cinnamon Teal	ANCY1	2	107	0.02	16.67	12	1302	0.009
	54	Cinnamon Teal	ANCY1	10	112	0.09	83.33	12	1302	0.009
	54	Common Goldeneye	BUCL1	3	112	0.03	100.00	3	1302	0.002
	10	Common Snipe	GAGA1	2	37	0.05	7.69	26	1302	0.020
	20	Common Snipe	GAGA1	10	104	0.10	38.46	26	1302	0.020
	30	Common Snipe	GAGA1	12	107	0.11	46.15	26	1302	0.020
	212	Common Snipe	GAGA1	2	105	0.02	7.69	26	1302	0.020
	54	Double-crested Cormorant	PHAU1	10	112	0.09	83.33	12	1302	0.009
	93	Double-crested Cormorant	PHAU1	2	6	0.33	16.67	12	1302	0.009
	30	Franklin's Gull	LAPI1	1	107	0.01	100.00	1	1302	0.001
	54	Gadwall	ANST1	18	112	0.16	100.00	18	1302	0.014
	54	Great Blue Heron	ARHE1	2	112	0.02	66.67	3	1302	0.002
	110	Great Blue Heron	ARHE1	1	301	0.00	33.33	3	1302	0.002
	30	Great egret	CAAL1	1	107	0.01	100.00	1	1302	0.001
	54	Green-winged Teal	ANCR1	25	112	0.22	86.21	29	1302	0.022
	93	Green-winged Teal	ANCR1	4	6	0.67	13.79	29	1302	0.022
	54	Killdeer	CHVO1	1	112	0.01	14.29	7	1302	0.005
	93	Killdeer	CHVO1	2	6	0.33	28.57	7	1302	0.005
	212	Killdeer	CHVO1	2	105	0.02	28.57	7	1302	0.005
	420	Killdeer	CHVO1	2	6	0.33	28.57	7	1302	0.005
	54	Lesser Scaup	AYAF1	3	112	0.03	100.00	3	1302	0.002
	54	Lesser Yellowlegs	TRFL1	1	112	0.01	50.00	2	1302	0.002
	93	Lesser Yellowlegs	TRFL1	1	6	0.17	50.00	2	1302	0.002
	54	Mallard	ANPL1	70	112	0.63	76.09	92	1302	0.071
	93	Mallard	ANPL1	11	6	1.83	11.96	92	1302	0.071

Table 3-9. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring (cont.)	110	Mallard	ANPL1	8	301	0.03	8.70	92	1302	0.071
	230	Mallard	ANPL1	3	147	0.02	3.26	92	1302	0.071
	54	Northern Shoveler	ANCL1	3	112	0.03	100.00	3	1302	0.002
	54	Pied-billed Grebe	POPO1	7	112	0.06	100.00	7	1302	0.005
	54	Redhead	AYAM1	6	112	0.05	100.00	6	1302	0.005
	54	Ring-necked Duck	AYCO1	29	112	0.26	100.00	29	1302	0.022
	30	Solitary Sandpiper	TRSO1	2	107	0.02	100.00	2	1302	0.002
	30	White-faced Ibis	PLCH1	6	107	0.06	100.00	6	1302	0.005
Summer	30	American Coot	FUAM1	6	109	0.06	10.17	59	1547	0.038
	54	American Coot	FUAM1	53	104	0.51	89.83	59	1547	0.038
	54	Black-crowned Night-heron	NYNY1	2	104	0.02	66.67	3	1547	0.002
	110	Black-crowned Night-heron	NYNY1	1	411	0.00	33.33	3	1547	0.002
	54	Blue-winged Teal	ANDI1	32	104	0.31	100.00	32	1547	0.021
	54	Canada Goose	BRCA1	12	104	0.12	70.59	17	1547	0.011
	93	Canada Goose	BRCA1	5	39	0.13	29.41	17	1547	0.011
	20	Common Snipe	GAGA1	1	98	0.01	14.29	7	1547	0.005
	30	Common Snipe	GAGA1	6	109	0.06	85.71	7	1547	0.005
	54	Double-crested Cormorant	PHAU1	23	104	0.22	92.00	25	1547	0.016
	93	Double-crested Cormorant	PHAU1	2	39	0.05	8.00	25	1547	0.016
	54	Gadwall	ANST1	7	104	0.07	100.00	7	1547	0.005
	54	Great Blue Heron	ARHE1	4	104	0.04	50.00	8	1547	0.005
	93	Great Blue Heron	ARHE1	4	39	0.10	50.00	8	1547	0.005
	54	Green-winged Teal	ANCR1	1	104	0.01	100.00	1	1547	0.001
	10	Killdeer	CHVO1	1	59	0.02	3.33	30	1547	0.019
	54	Killdeer	CHVO1	5	104	0.05	16.67	30	1547	0.019
	93	Killdeer	CHVO1	24	39	0.62	80.00	30	1547	0.019
	54	Mallard	ANPL1	137	104	1.32	82.53	166	1547	0.107
	93	Mallard	ANPL1	29	39	0.74	17.47	166	1547	0.107
	54	Pied-billed Grebe	POPO1	21	104	0.20	100.00	21	1547	0.014
	54	Ruddy Duck	OXJA1	1	104	0.01	100.00	1	1547	0.001
	54	Sora	POCA1	1	104	0.01	100.00	1	1547	0.001
	93	Spotted Sandpiper	ACMA1	5	39	0.13	100.00	5	1547	0.003

Table 3-9. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/Min	Percent Obs/Season	Total Obs/Season	Time in Season	Obs/Min for Sp./Season
Fall	54	American Coot	FUAM1	33	113	0.29	100.00	33	1356	0.024
	54	American Wigeon	ANAM1	5	113	0.04	100.00	5	1356	0.004
	54	Black-crowned Night-heron	NYNY1	2	113	0.02	66.67	3	1356	0.002
	212	Black-crowned Night-heron	NYNY1	1	164	0.01	33.33	3	1356	0.002
	54	Blue-winged Teal	ANDI1	23	113	0.20	100.00	23	1356	0.017
	54	Bufflehead	BUAL1	39	113	0.35	100.00	39	1356	0.029
	54	Cinnamon Teal	ANCY1	1	113	0.01	100.00	1	1356	0.001
	93	Double-crested Cormorant	PHAU1	1	4	0.25	100.00	1	1356	0.001
	30	Eared grebe	PONI1	1	125	0.01	100.00	1	1356	0.001
	54	Great Blue Heron	ARHE1	1	113	0.01	100.00	1	1356	0.001
	54	Green-winged Teal	ANCR1	9	113	0.08	100.00	9	1356	0.007
	10	Mallard	ANPL1	2	45	0.04	2.41	83	1356	0.061
	54	Mallard	ANPL1	80	113	0.71	96.39	83	1356	0.061
	93	Mallard	ANPL1	1	4	0.25	1.20	83	1356	0.061
	54	Pied-billed Grebe	POPO1	19	113	0.17	100.00	19	1356	0.014
	93	Ring-billed Gull	LADE1	1	4	0.25	100.00	1	1356	0.001
	54	Ring-necked Duck	AYCO1	33	113	0.29	100.00	33	1356	0.024
	110	Sora	POCA1	1	323	0.00	100.00	1	1356	0.001
Winter	54	American Coot	FUAM1	1	61	0.02	100.00	1	1053	0.001
	54	Bufflehead	BUAL1	13	61	0.21	100.00	13	1053	0.012
	54	Canada Goose	BRCA1	90	61	1.48	100.00	90	1053	0.085
	54	Common Goldeneye	BUCL1	1	61	0.02	100.00	1	1053	0.001
	54	Gadwall	ANST1	1	61	0.02	100.00	1	1053	0.001
	54	Green-winged Teal	ANCR1	8	61	0.13	100.00	8	1053	0.008
	54	Mallard	ANPL1	43	61	0.70	100.00	43	1053	0.041
	54	Redhead	AYAM1	3	61	0.05	100.00	3	1053	0.003
	54	Ring-necked Duck	AYCO1	11	61	0.18	100.00	11	1053	0.010
	54	Wood duck	AISP1	1	61	0.02	100.00	1	1053	0.001

Table 3-10. Raptor area use in 1999 based on sitewide significant species surveys

Season	RFGid	Common Name	Spec Code	Number
Spring	2 N	Ferruginous Hawk	BURE1	2
	2 U	Red-tailed Hawk	BUJA1	2
	3 M	Red-tailed Hawk	BUJA1	1
	4 L	Great Horned Owl	BUVI1	1
	5 P	Red-tailed Hawk	BUJA1	1
	7 I	Great Horned Owl	BUVI1	1
	7 I	Red-tailed Hawk	BUJA1	1
	11 M	Great Horned Owl	BUVI1	1
	11 N	American Kestrel	FASP1	1
	12 L	Red-tailed Hawk	BUJA1	1
	13 N	Red-tailed Hawk	BUJA1	2
	15 J	Great Horned Owl	BUVI1	1
	16 K	Swainson's Hawk	BUSW1	2
	16 L	Red-tailed Hawk	BUJA1	1
Summer	2 L	American Kestrel	FASP1	1
	2 O	Great Horned Owl	BUVI1	1
	2 O	Red-tailed Hawk	BUJA1	1
	3 T	Northern Harrier	CICY1	1
	4 L	Red-tailed Hawk	BUJA1	1
	5 R	Great Horned Owl	BUVI1	1
	7 I	American Kestrel	FASP1	1
	7 I	Red-tailed Hawk	BUJA1	1
	7 M	Swainson's Hawk	BUSW1	3
	11 J	American Kestrel	FASP1	1
	11 P	American Kestrel	FASP1	1
	12 K	American Kestrel	FASP1	1
	13 G	American Kestrel	FASP1	2
	13 H	Great Horned Owl	BUVI1	1
	15 Q	Great Horned Owl	BUVI1	1
Fall	2 O	Long-eared Owl	ASOT1	1
	3 F	American Kestrel	FASP1	2
	4 F	American Kestrel	FASP1	3
	5 J	American Kestrel	FASP1	3
	7 I	Red-tailed Hawk	BUJA1	1
	7 N	Red-tailed Hawk	BUJA1	1
	8 S	Red-tailed Hawk	BUJA1	1
	12 F	Northern Harrier	CICY1	1
	12 O	Red-tailed Hawk	BUJA1	1
	12 Q	American Kestrel	FASP1	1
	13 H	Northern Harrier	CICY1	1
	14 F	American Kestrel	FASP1	1
	14 H	Northern Harrier	CICY1	1
	14 H	Rough-legged Hawk	BULA1	1
	14 L	American Kestrel	FASP1	1
	15 N	Northern Harrier	CICY1	2

Table 3-10. (cont.)

Season	RFGrid	Common Name	Spec Code	Number
Winter	2 R	American Kestrel	FASP1	1
	2 T	Rough-legged Hawk	BULA1	1
	5 P	Red-tailed Hawk	BUJA1	1
	7 L	American Kestrel	FASP1	1
	10 F	Rough-legged Hawk	BULA1	1
	10 P	American Kestrel	FASP1	2
	10 P	Golden Eagle	AQCH1	2
	11 M	Great Horned Owl	BUVI1	3
	12 O	Great Horned Owl	BUVI1	1
	13 G	Great Horned Owl	BUVI1	1
	13 H	Golden Eagle	AQCH1	1
	13 H	Northern Harrier	CICY1	1
	13 R	Northern Harrier	CICY1	1
	14 N	Ferruginous Hawk	BURE1	1
	14 O	Red-tailed Hawk	BUJA1	1
	15 G	Rough-legged Hawk	BULA1	1
	16 K	Rough-legged Hawk	BULA1	1
	16 P	Bald Eagle	HALE1	1

Table 3-11. Raptor relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	110	American Kestrel	FASP1	6	301	0.02	75.00	8	1302	0.006
	212	American Kestrel	FASP1	1	105	0.01	12.50	8	1302	0.006
	323	American Kestrel	FASP1	1	139	0.01	12.50	8	1302	0.006
	323	Ferruginous Hawk	BURE1	1	139	0.01	100.00	1	1302	0.001
	110	Great Horned Owl	BUVI1	13	301	0.04	86.67	15	1302	0.012
	230	Great Horned Owl	BUVI1	2	147	0.01	13.33	15	1302	0.012
	10	Northern Harrier	CICY1	1	37	0.03	100.00	1	1302	0.001
	10	Red-tailed Hawk	BUJA1	1	37	0.03	8.33	12	1302	0.009
	110	Red-tailed Hawk	BUJA1	1	301	0.00	8.33	12	1302	0.009
	212	Red-tailed Hawk	BUJA1	5	105	0.05	41.67	12	1302	0.009
	230	Red-tailed Hawk	BUJA1	1	147	0.01	8.33	12	1302	0.009
	322	Red-tailed Hawk	BUJA1	4	181	0.02	33.33	12	1302	0.009
	10	Sharp-shinned Hawk	ACST1	1	37	0.03	25.00	4	1302	0.003
	230	Sharp-shinned Hawk	ACST1	2	147	0.01	50.00	4	1302	0.003
	322	Sharp-shinned Hawk	ACST1	1	181	0.01	25.00	4	1302	0.003
	110	Swainson's Hawk	BUSW1	2	301	0.01	100.00	2	1302	0.002
Summer	30	American Kestrel	FASP1	2	109	0.02	28.57	7	1547	0.005
	110	American Kestrel	FASP1	2	411	0.00	28.57	7	1547	0.005
	212	American Kestrel	FASP1	2	124	0.02	28.57	7	1547	0.005
	322	American Kestrel	FASP1	1	159	0.01	14.29	7	1547	0.005
	110	Great Horned Owl	BUVI1	7	411	0.02	77.78	9	1547	0.006
	212	Great Horned Owl	BUVI1	1	124	0.01	11.11	9	1547	0.006
	230	Great Horned Owl	BUVI1	1	202	0.00	11.11	9	1547	0.006
	20	Northern Harrier	CICY1	1	98	0.01	12.50	8	1547	0.005
	110	Northern Harrier	CICY1	1	411	0.00	12.50	8	1547	0.005
	230	Northern Harrier	CICY1	1	202	0.00	12.50	8	1547	0.005
	322	Northern Harrier	CICY1	3	159	0.02	37.50	8	1547	0.005
	323	Northern Harrier	CICY1	2	159	0.01	25.00	8	1547	0.005
	110	Red-tailed Hawk	BUJA1	2	411	0.00	33.33	6	1547	0.004
	230	Red-tailed Hawk	BUJA1	1	202	0.00	16.67	6	1547	0.004
	322	Red-tailed Hawk	BUJA1	3	159	0.02	50.00	6	1547	0.004

Table 3-11. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	110	Swainson's Hawk	BUSW1	4	411	0.01	66.67	6	1547	0.004
	322	Swainson's Hawk	BUSW1	1	159	0.01	16.67	6	1547	0.004
	324	Swainson's Hawk	BUSW1	1	23	0.04	16.67	6	1547	0.004
	230	Turkey Vulture	CAAU1	1	202	0.00	50.00	2	1547	0.001
	322	Turkey Vulture	CAAU1	1	159	0.01	50.00	2	1547	0.001
Fall	20	American Kestrel	FASP1	2	87	0.02	14.29	14	1356	0.010
	30	American Kestrel	FASP1	1	125	0.01	7.14	14	1356	0.010
	110	American Kestrel	FASP1	7	323	0.02	50.00	14	1356	0.010
	212	American Kestrel	FASP1	1	164	0.01	7.14	14	1356	0.010
	322	American Kestrel	FASP1	2	133	0.02	14.29	14	1356	0.010
	323	American Kestrel	FASP1	1	129	0.01	7.14	14	1356	0.010
	20	Golden Eagle	AQCH1	1	87	0.01	100.00	1	1356	0.001
	110	Great Horned Owl	BUVI1	8	323	0.02	88.89	9	1356	0.007
	212	Great Horned Owl	BUVI1	1	164	0.01	11.11	9	1356	0.007
	30	Northern Harrier	CICY1	1	125	0.01	25.00	4	1356	0.003
	54	Northern Harrier	CICY1	1	113	0.01	25.00	4	1356	0.003
	230	Northern Harrier	CICY1	2	186	0.01	50.00	4	1356	0.003
	110	Red-tailed Hawk	BUJA1	1	323	0.00	25.00	4	1356	0.003
	212	Red-tailed Hawk	BUJA1	1	164	0.01	25.00	4	1356	0.003
	322	Red-tailed Hawk	BUJA1	2	133	0.02	50.00	4	1356	0.003
	230	Rough-legged Hawk	BULA1	1	186	0.01	50.00	2	1356	0.001
	322	Rough-legged Hawk	BULA1	1	133	0.01	50.00	2	1356	0.001
Winter	20	American Kestrel	FASP1	1	93	0.01	10.00	10	1053	0.009
	211	American Kestrel	FASP1	2	28	0.07	20.00	10	1053	0.009
	212	American Kestrel	FASP1	3	63	0.05	30.00	10	1053	0.009
	322	American Kestrel	FASP1	3	152	0.02	30.00	10	1053	0.009
	323	American Kestrel	FASP1	1	127	0.01	10.00	10	1053	0.009
	322	Golden Eagle	AQCH1	1	152	0.01	100.00	1	1053	0.001
	110	Great Horned Owl	BUVI1	14	263	0.05	87.50	16	1053	0.015
	230	Great Horned Owl	BUVI1	2	136	0.01	12.50	16	1053	0.015
	20	Northern Harrier	CICY1	1	93	0.01	100.00	1	1053	0.001

Table 3-11. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Winter (cont.)	322	Prairie Falcon	FAME1	2	152	0.01	100.00	2	1053	0.002
	20	Red-tailed Hawk	BUJA1	1	93	0.01	33.33	3	1053	0.003
	110	Red-tailed Hawk	BUJA1	1	263	0.00	33.33	3	1053	0.003
	323	Red-tailed Hawk	BUJA1	1	127	0.01	33.33	3	1053	0.003
	323	Rough-legged Hawk	BULA1	2	127	0.02	100.00	2	1053	0.002

Table 3-12. Fish species found during pond sampling in 1999

Stream Drainage	Sample Location	Common Name	Spec Code
Rock Creek	Lindsay 2	Fathead Minnow	PIPR1
Rock Creek	Lindsay Pond	Largemouth Bass	MISA1
North Walnut Ceeek	Pond A-2	Fathead Minnow	PIPR1
North Walnut Ceeek	Pond A-3	Fathead Minnow	PIPR1
North Walnut Ceeek	Pond A-4	Fathead Minnow	PIPR1
Walnut Creek	Indiana Pond	Fathead Minnow	PIPR1
South Walnut Creek	Pond B-4	Fathead Minnow	PIPR1
South Walnut Creek	Pond B-5	Fathead Minnow	PIPR1
Woman Creek	Pond C-1	Smallmouth Bass	MIDO1
Woman Creek	Pond C-1	Fathead Minnow	PIPR1
Woman Creek	Pond C-1	Creek Chub	SEAT1
Woman Creek	Pond C-2	Fathead Minnow	PIPR1
Smart Ditch	Pond D-1	Fathead Minnow	PIPR1
Smart Ditch	Pond D-2	Fathead Minnow	PIPR1

**Table 3-13. Herptile area use in 1999 based on
sitewide significant species surveys**

Season	RFGid	Common Name	Spec Code	Number
Spring	7 J	Boreal Chorus Frog	PSTR1	2
	7 P	Boreal Chorus Frog	PSTR1	6
	10 O	Prairie rattlesnake	CRV11	1
	11 N	Boreal Chorus Frog	PSTR1	80
	12 F	Boreal Chorus Frog	PSTR1	10
	15 J	Boreal Chorus Frog	PSTR1	10
	16 L	Boreal Chorus Frog	PSTR1	50
Summer	3 R	Western Painted Turtle	CHPI1	2
	13 H	Western Painted Turtle	CHPI1	1

Table 3-14. Herptile relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	10	Boreal Chorus Frog	PSTR1	3	37	0.08	2.07	145	1302	0.111
	20	Boreal Chorus Frog	PSTR1	8	104	0.08	5.52	145	1302	0.111
	30	Boreal Chorus Frog	PSTR1	12	107	0.11	8.28	145	1302	0.111
	51	Boreal Chorus Frog	PSTR1	27	3	9.00	18.62	145	1302	0.111
	54	Boreal Chorus Frog	PSTR1	77	112	0.69	53.10	145	1302	0.111
	211	Boreal Chorus Frog	PSTR1	1	26	0.04	0.69	145	1302	0.111
	212	Boreal Chorus Frog	PSTR1	4	105	0.04	2.76	145	1302	0.111
	230	Boreal Chorus Frog	PSTR1	13	147	0.09	8.97	145	1302	0.111
	54	Northern Leopard Frog	RAPI1	4	112	0.04	100.00	4	1302	0.003
	30	Western Painted Turtle	CHPI1	17	107	0.16	68.00	25	1302	0.019
Summer	54	Western Painted Turtle	CHPI1	8	112	0.07	32.00	25	1302	0.019
	30	Bullfrog	RACA1	3	109	0.03	60.00	5	1547	0.003
	54	Bullfrog	RACA1	2	104	0.02	40.00	5	1547	0.003
	30	Northern Leopard Frog	RAPI1	2	109	0.02	20.00	10	1547	0.006
	93	Northern Leopard Frog	RAPI1	8	39	0.21	80.00	10	1547	0.006
	323	Short-horned lizard	PHDO1	11	159	0.07	100.00	11	1547	0.007
	54	Snapping Turtle	CHSE1	1	104	0.01	100.00	1	1547	0.001
	30	Western Painted Turtle	CHPI1	9	109	0.08	20.93	43	1547	0.028
	54	Western Painted Turtle	CHPI1	26	104	0.25	60.47	43	1547	0.028
Fall	93	Western Painted Turtle	CHPI1	8	39	0.21	18.60	43	1547	0.028
	30	Bullfrog	RACA1	1	125	0.01	50.00	2	1356	0.001
	54	Bullfrog	RACA1	1	113	0.01	50.00	2	1356	0.001
	54	Western Painted Turtle	CHPI1	62	113	0.55	100.00	62	1356	0.046

Table 3-15. Special-concern species search list for the Rocky Flats Environmental Technology Site (effective date May 8, 2000)

Delisted Species Known to Occur at Rocky Flats

Birds

American Peregrine Falcon (*Falco peregrinus*)¹

Federal Threatened Species Known to Occur at Rocky Flats

Birds

Bald Eagle (*Haliaeetus leucocephalus*)³

Mammals

Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)^{4,5,6,7}

Federal Special-Concern Species Known to Occur at Rocky Flats

Reptiles

Eastern Short Horned Lizard (*Phrynosoma douglassii brevirostra*)^{5,8}

Birds

Northern Goshawk (*Accipiter gentilis*)^{5,8}

Baird's Sparrow (*Ammodramus bairdii*)^{5,8}

Western Burrowing Owl (*Athene cunicularia hypugea*)^{2,4,5,9}

Ferruginous Hawk (*Buteo regalis*)^{4,5,7}

Black Swift (*Cypseloides niger*)^{5,8}

Loggerhead Shrike (*Lanius ludovicianus*)^{4,5}

White-faced Ibis (*Plegadis chihi*)⁵

Mammals

Small-footed Myotis (*Myotis subulatus* = *M. ciliolabrum*)^{5,8}

Black-tailed Prairie Dog (*Cynomys ludocivianus*)¹⁹

Colorado Species of Special Concern Known to Occur at Rocky Flats

Amphibians

Northern Leopard Frog (*Rana pipiens*)⁸

Birds

Long-billed Curlew (*Numenius americanus*)^{7,8}

Greater Sandhill Crane (*Grus canadensis tibida*)^{8,2}

American White Pelican (*Pelecanus erythrorhynchos*)^{4,8}

Federal Endangered Species with Potential Habitat at Rocky Flats

Birds

Whooping Crane (*Grus americana*)

Least Tern (*Sterna antillarum*)

Piping Plover (*Charadrius melodus*)

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)¹⁰

Mammals

Black-footed Ferret (*Mustela nigripes*)¹¹

Table 3-15 (cont.)

Federal Threatened Species with Potential Habitat at Rocky Flats

Plants

Ute Ladies'-tresses (*Spiranthes diluvialis*)¹²

Insects

Pawnee Montane Skipper (*Hesperia leonardus montana*)

Federal Proposed Species with Potential Habitat at Rocky Flats

Plants

Colorado Butterfly Plant (*Gaura neomexicana* var. *coloradensis*)¹³

Federal Candidate Species with Potential Habitat at Rocky Flats

Birds

Mountain Plover (*Charadrius montanus*)¹⁴

Federal Special-Concern Species with Potential Habitat at Rocky Flats

Plants

Bell's Twinpod (*Physaria bellii*)⁵

Tulip Gentian (*Eustoma grandiflora*)⁵

Adder's Mouth Orchid (*Malaxis brachypoda*)⁵

Insects

Regal Fritillary (*Speyeria idalia*)⁵

Fish

Plains Topminnow (*Fundulus sciadicus*)⁵

Birds

Western Snowy Plover (*Charadrius alexandrinus nivosus*)⁵

Black Tern (*Chlidonias niger*)⁵

Mammals

Spotted Bat (*Euderma maculatum*)⁵

Long-eared Myotis (*Myotis evotis*)⁵

Fringed Bat (*Myotis thysanodes*)⁵

Long-legged Myotis (*Myotis volans*)⁵

Pale Townsend's Big-eared Bat (*Plecotus townsendii pallascens*)⁵

Plains Spotted Skunk (*Spilogale putorius interrupta*)⁵

Swift Fox (*Vulpes velox*)^{11,5}

Colorado Threatened Species with Potential Habitat at Rocky Flats

Fish

Common Shiner (*Notropis cornutus*)¹⁴

Colorado Species of Special Concern with Potential Habitat at Rocky Flats

Fish

Stonecat (*Noturus flavus*)¹⁴

Birds

Barrow's Goldeneye (*Bucephala islandica*)¹⁴

Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*)¹⁵

Table 3-15 (cont.)

Watch-Listed Species Known to Occur at Rocky Flats

Reptiles

Red-sided Garter (*Thamnophis sirtalis*)
Western Yellowbelly Racer (*Clouber constrictor*)

Birds

Black-crowned Night-heron (*Nycticorax nycticorax*)¹⁶
American Bittern (*Botarus lentiginosus*)¹⁶
Bufflehead (*Bucephala albeola*)¹⁶
Eared Grebe (*Podiceps nigricollis*)¹⁶
Sora (*Porzana carolina*)¹⁶
Cooper's Hawk (*Accipiter cooperii*)¹⁶
Sharp-shinned Hawk (*Accipiter striatus*)¹⁶
Golden Eagle (*Aquila chrysaetos*)¹⁶
Swainson's Hawk (*Buteo swainsoni*)¹⁷
Northern Harrier (*Circus cyaneus*)¹⁸
Merlin (*Falco columbarius*)¹⁶
Prairie Falcon (*Falco mexicanus*)¹⁶
Short-eared Owl (*Asio flammeus*)¹⁸
Long-eared Owl (*Asio otus*)¹⁶
Olive-sided Flycatcher (*Contopus borealis*)¹⁸
Chestnut-sided Warbler (*Dendroica pensylvanica*)¹⁸
Virginia's Warbler (*Vermivora virginiae*)¹⁸
Baird's Sparrow (*Ammodramus bairdi*)¹⁸
Grasshopper Sparrow (*Ammodramus savannarum*)¹⁸
Lark Bunting (*Calamospiza melanocorys*)¹⁸
Chestnut-collared Longspur (*Calcarius ornatus*)¹⁸
Field Sparrow (*Spizella pusilla*)¹⁸

Mammals

Olive-backed Pocket Mouse (*Perognathus faciatus* spp.)¹⁶
Plains Pocket Mouse (*Perognathus flavescens*)¹⁶
Silky Pocket Mouse (*Perognathus flavus*)¹⁶
Merriam's Shrew (*Sorex merriami*)¹⁶
Northern Pocket Gopher (*Thomomys talpoides* ssp.)¹⁶

NOTES:

1. The species *Falco peregrinus* was delisted by the U.S. Fish and Wildlife Service in 1999.
2. Colorado State threatened species (ST).
3. The USFWS has down-listed the bald eagle to threatened status.
4. This species is resident or regularly visits Rocky Flats.
5. In February 1996, the U.S. Fish and Wildlife Service (USFWS) revised the list of candidate species to include only proposed and C1 species. All former candidate species except C1 species are now classified unofficially as "at-risk" and are still considered special-concern species. The search-list includes these species because they may be upgraded to C-1 species at any time.
6. In May 1998, the USFWS listed the Preble's meadow jumping mouse as a threatened species.
7. Colorado species of special concern (SC).
8. The species has been observed infrequently on Rocky Flats.
9. Listed on August 20, 1997.
10. Species was listed as a State threatened species May 8, 1998.
11. This species was previously collected near Rocky Flats.

Table 3-15 (cont.)

12. These species have historically used areas in the vicinity, and suitable feeding or residential habitat exists at Rocky Flats.
13. Proposed for listing as threatened on March 24, 1998.
14. Federal candidate species for listing as threatened or endangered.
15. Colorado State endangered species.
16. Colorado Natural Heritage Program list of rare and imperiled species.
17. Species of special interest to the Colorado Division of Wildlife due to recent winter range die-off of the species.
18. Birds listed by the USFWS as "Migratory Nongame Birds of Management Concern: The 1995 List" that occur at the Site.
19. Although the U.S. Fish and Wildlife Service declined to list the black-tailed prairie dog in 2000, it has been added to the list of candidate species, and may be listed in the future.

Note: Candidate, proposed, and listed species lists are under constant revision. As data are reviewed by the USFWS, species are added to and removed from this list on a year-round basis. This list for Rocky Flats Environmental Technology Site is updated annually.

Sources:

1. Colorado Natural Heritage Program 1996 List of Rare and Imperiled Animals, Plants, and Natural Communities.
 2. Federal Register, February 28, 1996, pp. 7596-7613.
 3. Migratory Nongame Birds of Management Concern in the United States: The 1995 List.
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**Table 3-16. Bird distribution by habitat based on observations from 1991, 1993-1999
(total number of species = 194)**

Species	Species	Spec	Seasonal Abundance				Habitats				Neotrop	Breeding	
Common Name	Scientific Name	Code	Sp	Su	Fa	Wi	G	D	T	R	W	Mig (1)	Status
GREBES			PODICIPEDIDAE										
Western Grebe	<i>Aechmophorus occidentalis</i>	AEOC1	R		R							X	
Eared Grebe	<i>Podiceps nigricollis</i>	PONI1	R		R							X	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	POPO1	U	U	U							X	Confirmed
PELICANS			PELECANIDAE										
American White Pelican (2)	<i>Pelecanus erythrorhynchos</i>	PEER1	O	O								X	
CORMORANTS			PHALACROCORACIDAE										
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	PHAU1	O	C	O			X				X	
HERONS			ARDEIDAE										
Great Blue Heron	<i>Ardea herodias</i>	ARHE1	U	C	U		X		X	X	X		
Great Egret*	<i>Casmerodius albus</i>	CAAL1	R									X	
American Bittern	<i>Botarus lentiginosus</i>	BOLE1		R								X	
Green-backed Heron	<i>Butorides striatus</i>	BUST1	O									X	
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>	NYNY1	U	C				X	X	X	X		Confirmed
White-faced Ibis (3)	<i>Plegadis chihi</i>	PLCH1		R								X	
GEESE AND DUCKS			ANATIDAE										
Wood Duck	<i>Aix sponsa</i>	AISP1		R								X	Confirmed
Northern Pintail	<i>Anas acuta</i>	ANAC1	O	O								X	
American Wigeon	<i>Anas americana</i>	ANAM1	O	O		O						X	
Northern Shoveler	<i>Anas clypeata</i>	ANCL1	U	U	U							X	
Green-winged Teal	<i>Anas crecca</i>	ANCR1	C	U	O	U						X	
Cinnamon Teal	<i>Anas cyanoptera</i>	ANCY1	C	O								X	
Blue-winged Teal	<i>Anas discors</i>	ANDI1	C	O	C							X	Confirmed
Mallard	<i>Anas platyrhynchos</i>	ANPL1	A	A	C	C	X	X	X	X	X	X	Confirmed
Gadwall	<i>Anas strepera</i>	ANST1	C	U	U							X	Confirmed
Greater Scaup	<i>Aythya marila</i>	AYMA1	O		O							X	
Lesser Scaup	<i>Aythya affinis</i>	AYAF1	C		U	U						X	
Redhead	<i>Aythya americana</i>	AYAM1	U	U		U						X	Confirmed
Ring-necked Duck	<i>Aythya collaris</i>	AYCO1	U		U							X	
Canvasback	<i>Aythya valisineria</i>	AYVA1				U						X	
Canada Goose	<i>Branta canadensis</i>	BRCA1	U	U	U	U	X			X	X		Confirmed
Bufflehead	<i>Bucephala albeola</i>	BUAL1	U		C	U		X		X	X		
Common Goldeneye	<i>Bucephala clangula</i>	BUCL1	U		U	U							
Snow Goose	<i>Chen caerulescens</i>	CHCA1			U		X					X	
Hooded Merganser	<i>Lophodytes cucullatus</i>	LOCU1	O									X	
Common Merganser	<i>Mergus merganser</i>	MEME1	U		O							X	
Ruddy Duck	<i>Oxyura jamaciensis</i>	OXJA1	R	R	R							X	Confirmed
AMERICAN VULTURES			CATHARTIDAE										
Turkey Vulture	<i>Cathartes aura</i>	CAAU1	O	O	O		X	X	X	X	X	X	Yes
Black Vulture*	<i>Coragyps atratus</i>	COAT1			R							X	

Table 3-16. (cont.)

Species Common Name	Species Scientific Name	Spec Code	Seasonal Abundance				Habitats							Neotrop Mig (1)	Breeding Status
Sp	Su	Fa	Wi	G	D	T	R	W	M						
EAGLES AND HAWKS ACCIPITRIDAE															
Cooper's Hawk	<i>Accipiter cooperii</i>	ACCO1		R	R		X							Yes	
Northern Goshawk (3)	<i>Accipiter gentilis</i>	ACGE1					R	X	X					Yes	
Sharp-shinned Hawk	<i>Accipiter striatus</i>	ACST1	U		U		X	X	X	X				Yes	
Golden Eagle	<i>Aquila chrysaetos</i>	AQCH1	O	O	O	O	X	X	X	X	X			Yes	
Red-tailed Hawk	<i>Buteo jamaicensis</i>	BUJA1	C	C	C	C	X	X	X	X	X			Yes	Confirmed
Rough-legged Hawk	<i>Buteo lagopus</i>	BULA1	O		C	C	X	X	X	X	X				
Ferruginous Hawk (2,3)	<i>Buteo regalis</i>	BURE1	U	U	U	U	X	X	X	X	X			Yes	
Swainson's Hawk	<i>Buteo swainsoni</i>	BUSW1	U	U	O		X	X	X	X				Yes	Confirmed
Northern Harrier	<i>Circus cyaneus</i>	CICY1	O	U	O	U	X	X	X	X	X			Yes	Suspected
Bald Eagle (4)	<i>Haliaeetus leucocephalus</i>	HALE1			O	O	X	X			X				
Osprey	<i>Pandion haliaetus</i>	PAHA1		R	R						X				
FALCONS FALCONIDAE															
Merlin	<i>Falco columbarius</i>	FACO1	R				R		X	X				Yes	
Prairie Falcon	<i>Falco mexicanus</i>	FAME1	O		O	O	X	X	X	X				Yes	
Peregrine Falcon	<i>Falco peregrinus</i>	FAPE1	R		R	R	X	X	X	X				Yes	
American Kestrel	<i>Falco sparverius</i>	FASP1	O	U	U	O	X	X	X	X	X			Yes	Confirmed
GROUSE AND TURKEYS PHASIANIDAE															
Wild Turkey	<i>Meleagris gallopavo</i>	MEGA1	R				X								
Ring-necked Pheasant	<i>Phasianus colchicus</i>	PHCO1	U	U	U	U	X		X	X	X				Suspected
RAILS AND COOTS RALLIDAE															
American Coot	<i>Fulica americana</i>	FUAM1	U	U	U		X		X	X				Confirmed	
Sora	<i>Porzana carolina</i>	POCA1		U						X				Suspected	
Virginia Rail	<i>Rallus limicola</i>	RAL11	U							X				Suspected	
CRANES GRUIDAE															
Sandhill Crane (2)	<i>Grus canadensis</i>	GRCA1			O		X		X						
PLOVERS CHARADRIIDAE															
Killdeer	<i>Charadrius vociferus</i>	CHVO1	C	C	U		X	X	X	X	X			Confirmed	
STILTS AND AVOCETS RECURVIROSTRIDAE															
American Avocet	<i>Recurvirostra americana</i>	REAM1	U							X					
SANDPIPERS AND ALLIES SCOLOPACIDAE															
Spotted Sandpiper	<i>Actitis macularia</i>	ACMA1	C	U						X					
Pectoral Sandpiper	<i>Calidris melanotos</i>	CAME1	O	O						X					
Semipalmated Sandpiper	<i>Calidris pusilla</i>	CAPU1	R							X					
Willet	<i>Catoptrophorus semipalmatus</i>	CASE1	U	O						X					
Common Snipe	<i>Gallinago gallinago</i>	GAGA1	U	C	U				X	X	X			Confirmed	
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	LISC1	O							X					
Long-billed Curlew (2)	<i>Numenius americanus</i>	NUAM1	R			R	X	X						Yes	
Wilson's Phalarope	<i>Phalaropus tricolor</i>	PHTR1	U							X					
Lesser Yellowlegs	<i>Tringa flavipes</i>	TRFL1	O	O						X					
Greater Yellowlegs	<i>Tringa melanoleuca</i>	TRME1		R						X					
Solitary Sandpiper	<i>Tringa solitaria</i>	TRSO1	U	O						X					
GULLS LARIDAE															
Ring-billed Gull	<i>Larus delawarensis</i>	LADE1	C	O	O	O	X	X	X	X					
Franklin's Gull	<i>Larus pipixcan</i>	LAPI1			O		X			X					

Table 3-16. (cont.)

Species Common Name	Species Scientific Name	Spec Code	Seasonal Abundance				Habitats							Neotrop Mig (1)	Breeding Status
Sp	Su	Fa	Wi	G	D	T	R	W	M						
PIGEONS AND DOVES		COLUMBIDAE													
Band-tailed Pigeon	<i>Columba fasciata</i>	COFA1		O			X							Yes	Confirmed
Rock Dove	<i>Columba livia</i>	COLI1	C	C	C	C	X	X	X	X	X				Confirmed
Mourning Dove	<i>Zenaidura macroura</i>	ZEMA1	C	C	C		X	X	X	X	X				Confirmed
CUCKOOS		CUCULIDAE													
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	COER1		R						X				Yes	
OWLS		STRIGIDAE													
Short-eared Owl	<i>Asio flammeus</i>	ASFL1	O	O	O	O	X	X	X	X				Yes	
Long-eared Owl	<i>Asio otus</i>	ASOT1	O	O	O			X	X	X				Yes	
Burrowing Owl (5)	<i>Athene cunicularia</i>	ATCU1	R	R			X							Yes	
Great Horned Owl	<i>Bubo virginianus</i>	BUVI1	C	C	C	C	X	X	X	X	X				Confirmed
Barn Owl	<i>Tyto alba</i>	TYAL1			R					X					
NIGHT JARS		CAPRIMULGIDAE													
Common Nighthawk	<i>Chordeiles minor</i>	CHMI1	U	U			X	X	X	X	X			Yes	Confirmed
Common Poorwill	<i>Phalaenoptilus nuttallii</i>	PHNU1		C			X	X						Yes	
SWIFTS		APODIDAE													
Black Swift (3)	<i>Cypseloides niger</i>	CYNI1	R				X							Yes	
HUMMINGBIRDS		TROCHILIDAE													
Broad-tailed Hummingbird	<i>Selasphorus platycercus</i>	SEPL1		O			X	X	X	X				Yes	Suspected
Rufous Hummingbird	<i>Selasphorus rufus</i>	SERU1		O					X					Yes	
KINGFISHERS		ALCEDINIDAE													
Belted Kingfisher	<i>Ceryle alcyon</i>	CEAL1	O	O	O					X	X			Yes	
WOODPECKERS		PICIDAE													
Northern Flicker	<i>Colaptes auratus</i>	COAU1	U	U	C	C	X	X	X	X	X				Suspected
Downy Woodpecker	<i>Picoides pubescens</i>	PIPU1		O	O	O		X	X	X					Suspected
Hairy Woodpecker	<i>Picoides villosus</i>	PIVI1			O			X	X	X					
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>	SPNU1			O					X				Yes	
TYRANT FLYCATCHERS		TYRANNIDAE													
Olive-sided Flycatcher	<i>Contopus borealis</i>	COBO1			O					X				Yes	
Western Wood-Pewee	<i>Contopus sordidulus</i>	COSO1	U	U	O		X	X	X	X				Yes	
Hammond's Flycatcher	<i>Empidonax hammondi</i>	EMHA1	U							X				Yes	
Dusky Flycatcher	<i>Empidonax oberholseri</i>	EMOB1	U		O					X	X			Yes	
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	EMDI1	U		O			X	X	X				Yes	
Willow Flycatcher	<i>Empidonax traillii</i>	EMTR1	U							X				Yes	
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	MYCI1	R					X						Yes	
Eastern Phoebe	<i>Sayornis phoebe</i>	SAPH1	R							X				Yes	
Say's Phoebe	<i>Sayornis saya</i>	SASA1	C	C	U		X	X	X	X	X	X		Yes	Confirmed
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	TYFO1	R				X							Yes	
Eastern Kingbird	<i>Tyrannus tyrannus</i>	TYTY1	O	C			X	X	X	X	X			Yes	Confirmed
Western Kingbird	<i>Tyrannus verticalis</i>	TYVE1	C	C	U		X	X	X	X	X			Yes	Confirmed
LARKS		ALAUDIDAE													
Horned Lark	<i>Eremophila alpestris</i>	ERAL1	U	O	U	C	X	X	X	X	X			Yes	Confirmed

Table 3-16. (cont.)

Species Common Name	Species Scientific Name	Spec Code	Seasonal Abundance				Habitats							Neotrop Mig (1)	Breeding Status
Sp	Su	Fa	Wi	G	D	T	R	W	M						
SWALLOWS		HIRUNDINIDAE													
Cliff Swallow	<i>Hirundo pyrrhonota</i>	HIPY1	U	C	U			X	X	X	X	X	X	Yes	Confirmed
Barn Swallow	<i>Hirundo rustica</i>	HIRU1	C	A	U			X	X	X	X	X	X	Yes	Confirmed
Northern Rough-winged Swallow	<i>Steigodopteryx serripennis</i>	STSE1	O					X				X		Yes	
Tree Swallow	<i>Tachycineta bicolor</i>	TAB11	C	C	O			X	X	X	X	X		Yes	Suspected
Violet-green Swallow	<i>Tachycineta thalassina</i>	TATH1	U	U				X	X	X	X	X		Yes	Suspected
CROWS, JAYS, MAGPIES		CORVIDAE													
American Crow	<i>Corvus brachyrhynchos</i>	COBR1	O	O	O	O	X	X							
Common Raven	<i>Corvus corax</i>	COCO1	U	O	O	U	X	X	X	X	X	X			Confirmed
Blue Jay	<i>Cyanocitta cristata</i>	CYCR1		U	U		X	X	X	X	X				
Pinyon Jay	<i>Gymnorhinus cyanocephalus</i>	GYCY1			O							X			
Black-billed Magpie	<i>Pica pica</i>	PIPI1	C	C	C	C	X	X	X	X	X	X			Confirmed
TITMICE		PARIDAE													
Black-capped Chickadee	<i>Parus atricapillus</i>	PAAT1	O	O	O	O		X	X	X					Confirmed
Mountain Chickadee	<i>Parus gambeli</i>	PAGA1	R								X				
NUTHATCHES		SITIDAE													
Red-breasted Nuthatch	<i>Sitta canadensis</i>	SICA2				R					X				
White-breasted Nuthatch	<i>Sitta carolinensis</i>	SICA1	U								X				
WRENS		TROGLODYTIDAE													
Marsh Wren	<i>Cistothorus palustris</i>	CIPA1	U	U	U			X			X		Yes		Suspected
Rock Wren	<i>Salpinctes obsoletus</i>	SAOB1	C	C	U			X	X		X	X			
House Wren	<i>Troglodytes aedon</i>	TRAE1	U	O	O			X	X	X	X		Yes		Suspected
Winter Wren	<i>Troglodytes troglodytes</i>	TRTR1				R					X				
MUSCICAPIDS		MUSCICAPIDAE													
Hermit Thrush	<i>Catharus guttatus</i>	CAGU1	U					X	X	X			Yes		
Swainson's Thrush	<i>Catharus ustulatus</i>	CAUS1		U				X	X				Yes		
Townsend's Solitaire	<i>Myadestes townsendi</i>	MYTO1	U				O				X	X	Yes		
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	POCA2	U			R		X	X	X			Yes		Confirmed
Ruby-crowned Kinglet	<i>Regulus calendula</i>	RECA1				C					X		Yes		Suspected
Golden-crowned Kinglet	<i>Regulus satrapa</i>	RESA1			R			X	X	X					
Mountain Bluebird	<i>Sialia currucoides</i>	SICU1	U		U			X	X				Yes		
Western Bluebird	<i>Sialia mexicana</i>	SIME1	R								X		Yes		
American Robin	<i>Turdus migratorius</i>	TUMI1	C	C	U	O	X	X	X	X	X	X	Yes		Confirmed
THRASHERS		MIMIDAE													
Gray Catbird	<i>Dumetella carolinensis</i>	DUCA1	U	U							X		Yes		Suspected
Northern Mockingbird	<i>Mimus polyglottos</i>	MIPO1	R	R	R			X		X	X				Suspected
Sage Thrasher	<i>Oreoscoptes montanus</i>	ORMO1	U	U	U			X	X	X	X	X	Yes		Suspected
Brown Thrasher	<i>Toxostoma rufum</i>	TORU1			R						X				
PIPITS		MOTACILLIDAE													
American Pipit	<i>Anthus rubescens</i>	ANRU1	U		U			X			X		Yes		
WAXWINGS		BOMBYCILLIDAE													
Bohemian Waxwing	<i>Bombicilla garrulus</i>	BOGA1						U		X					
SHRIKES		LANIIDAE													
Northern Shrike	<i>Lanius excubitor</i>	LAEX1						O			X				
Loggerhead Shrike (3)	<i>Lanius ludovicianus</i>	LALU1	U	O	O	O	X	X	X	X	X	X	Yes		Suspected

Table 3-16. (cont.)

Species Common Name	Species Scientific Name	Spec Code	Seasonal Abundance				Habitats							Neotrop Mig (1)	Breeding Status
Sp	Su	Fa	Wi	G	D	T	R	W	M						
STARLINGS STURNIDAE															
European Starling	<i>Sturnus vulgaris</i>	STVU1	C	A	C	U	X	X	X	X	X	X			Confirmed
VIREOS VIREONIDAE															
Warbling Vireo	<i>Vireo gilvus</i>	VEGI1	U	U					X				Yes		Suspected
Solitary Vireo	<i>Vireo solitarius</i>	VISO1			O				X				Yes		
WOOD WARBLERS EMBERIZIDAE: Parulinae															
Yellow-rumped Warbler	<i>Dendroica coronata</i>	DECO1	C	O	C				X	X	X		Yes		
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	DENI1					R		X	X			Yes		
Palm Warbler	<i>Dendroica palmarum</i>	DEPA1					R		X			X	Yes		
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	DEPE2		R					X				Yes		Suspected
Yellow Warbler	<i>Dendroica petechia</i>	DEPE1	C	C	C			X	X	X	X	X	Yes		Confirmed
Townsend's Warbler	<i>Dendroica townsendi</i>	DETO1				O						X	Yes		
Common Yellowthroat	<i>Geothlypis trichas</i>	GETR1	U	C	C			X	X	X	X	X	Yes		Confirmed
Yellow-breasted Chat	<i>Icteria virens</i>	ICVI1	U						X	X			Yes		Suspected
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	OPTO1				U		X	X	X	X	X	Yes		
Ovenbird	<i>Seiurus aurocapillus</i>	SEAU1		R					X	X			Yes		
American Redstart	<i>Setophaga ruticilla</i>	SERU2		R					X				Yes		
Virginia's Warbler	<i>Vermivora virginiae</i>	VEVI1				R				X			Yes		
Wilson's Warbler	<i>Wilsonia pusilla</i>	WIPU1				U			X	X	X	X	Yes		
Orange-crowned Warbler*	<i>Vermivora celata</i>	VECL1	R	R					X	X			Yes		Suspected
TANAGERS EMBERIZIDAE: Thraupinae															
Western Tanager	<i>Piranga ludoviciana</i>	PILU1	U		U					X			Yes		
GROSBEAKS AND ALLIES EMBERIZIDAE: Cardinalinae															
Blue Grosbeak	<i>Guiraca caerulea</i>	GUCA1	U	C	U			X	X	X	X		Yes		Confirmed
Lazuli Bunting	<i>Passerina amoena</i>	PAAM1	O	O					X	X			Yes		
Indigo Bunting	<i>Passerina cyanea</i>	PACY1	O	O						X			Yes		
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	PHME1			O					X			Yes		
TOWHEES AND SPARROWS EMBERIZIDAE: Emberizinae															
Baird's Sparrow (3)	<i>Ammodramus bairdii</i>	AMBA1	R		R			X	X				Yes		
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	AMSA1	C	C	U			X	X	X	X	X	Yes		Confirmed
Lark Bunting	<i>Calamospiza melanocorys</i>	CAME3	O	O	O			X	X				Yes		
Lapland Longspur	<i>Calcarius lapponicus</i>	CALA1					O	X							
Chestnut-collared Longspur	<i>Calcarius ornatus</i>	CAOR1					R	X					Yes		
Snow Bunting	<i>Plectrophenax nivalis</i>	PLNI1				R	R	X							
Lark Sparrow	<i>Chondestes grammacus</i>	CHGR1		O	O				X		X		Yes		Suspected
Dark-eyed Junco	<i>Junco hyemalis</i>	JUHY1	U	U	U		O	X	X	X	X	X	Yes		Suspected
Lincoln's Sparrow	<i>Melospiza lincolni</i>	MELI1	U		U					X	X		Yes		
Fox Sparrow	<i>Passerella iliaca</i>	PAIL1			R				X						
Song Sparrow	<i>Melospiza melodia</i>	MEME2	C	C	C	U	X	X	X	X	X	X			Confirmed
Savannah Sparrow	<i>Passerculus sandwichensis</i>	PASA1	U	U	U		X	X	X	X	X	X	Yes		Suspected
Green-tailed Towhee	<i>Pipilo chlorurus</i>	PICH1	U	U	O			X	X	X			Yes		Suspected
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>	PIER1	C	C	C	O	X	X	X	X	X	X	Yes		Confirmed
Vesper Sparrow	<i>Poocetes gramineus</i>	POGR1	A	A	C		X	X	X	X	X	X	Yes		Confirmed
American Tree Sparrow	<i>Spizella arborea</i>	SPAR1	U		U	C	X	X	X	X	X	X			
Brewer's Sparrow	<i>Spizella breweri</i>	SPBR1		U	C		X	X	X	X			Yes		
Field Sparrow	<i>Spizella pusilla</i>	SPPU1		R				X							
Clay-colored Sparrow	<i>Spizella pallida</i>	SPPA2			U	U	X	X	X	X	X		Yes		
Chipping Sparrow	<i>Spizella passerina</i>	SPPA1	U	U	C	O	X	X	X	X	X	X	Yes		
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	ZOLE1	C		C		X	X	X	X					
Harris' Sparrow	<i>Zonotrichia querula</i>	ZOQU1				R			X						

Table 3-16. (cont.)

Species Common Name	Species Scientific Name	Spec Code	Seasonal Abundance				Habitats				Neotrop	Breeding		
			Sp	Su	Fa	Wi	G	D	T	R	W	M	Mig (1)	Status
MEADOWLARKS, BLACKBIRD, EMBERIZIDAE: Icterinae														
Red-winged Blackbird	Agelaius phoeniceus	AGPH1	A	A	C	U	X	X	X	X	X		Yes	Confirmed
Brewer's Blackbird	Euphagus cyanocephalus	EUCY1	C	U	O		X	X	X	X	X		Yes	Confirmed
Northern Oriole	Icterus galbula	ICGA1	C	C			X	X	X	X	X		Yes	Confirmed
Brown-headed Cowbird	Molothrus ater	MOAT1	U	C			X	X	X	X	X		Yes	Suspected
Common Grackle	Quiscalus quiscula	QUQU1	U	C	O		X	X	X	X	X			Confirmed
Western Meadowlark	Sturnella neglecta	STNE1	A	A	A	O	X	X	X	X	X	X	Yes	Confirmed
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	XAXA1	C	C							X	X	Yes	Confirmed
FINCHES, FRINGILLIDAE														
Pine Siskin	Carduelis pinus	CAP11	U	O	O	O	X	X	X	X	X		Yes	
Lesser Goldfinch	Carduelis psaltria	CAPS1	O	U	O		X	X	X	X	X		Yes	Suspected
American Goldfinch	Carduelis tristis	CATR1	C	A	C	O	X	X	X	X	X	X	Yes	Confirmed
Cassin's Finch	Carpodacus cassinii	CACA2	R							X			Yes	
House Finch	Carpodacus mexicanus	CAME2	A	A	A	U	X	X	X	X	X	X		Confirmed
OLD WORLD SPARROWS, PASSERIDAE														
House Sparrow	Passer domesticus	PADO1	C	C	C	C	X	X			X			Confirmed
DEFINITIONS														
SEASONS			HABITATS			RELATIVE ABUNDANCE								
Sp = Spring			G = Grassland			(In appropriate habitat for species)								
Su = Summer			D = Disturbed			A = Abundant								
Fa = Fall			T = Tall Upland Shrubland			C = Common								
Wi = Winter			R = Riparian Shrubland			U = Uncommon								
			W = Woodland			O = Occasional								
			M = Marshland			R = Rare at the Site								
NOTE														
Taxonomic organization of table follows "Colorado Birds: A reference to their distribution and habitat," Andrews & Righter, 1992.														
(1) Neotropical Migrants are a migratory bird group of concern due to significant population declines over two continents.														
(2) A Colorado Species of Special Concern														
(3) Federal special-concern species														
(4) Federal threatened or endangered species														
(5) State threatened species														
*New species for 1999														

Table 3-17. Migratory bird relative abundance by habitat in 1999 based on multi-species census surveys

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring	30	American Goldfinch	CATR1	1	107	0.01	5.56	18	1302	0.014
	110	American Goldfinch	CATR1	10	301	0.03	55.56	18	1302	0.014
	211	American Goldfinch	CATR1	1	26	0.04	5.56	18	1302	0.014
	212	American Goldfinch	CATR1	3	105	0.03	16.67	18	1302	0.014
	230	American Goldfinch	CATR1	3	147	0.02	16.67	18	1302	0.014
	20	American Robin	TUMI1	1	104	0.01	1.75	57	1302	0.044
	110	American Robin	TUMI1	27	301	0.09	47.37	57	1302	0.044
	212	American Robin	TUMI1	17	105	0.16	29.82	57	1302	0.044
	230	American Robin	TUMI1	9	147	0.06	15.79	57	1302	0.044
	322	American Robin	TUMI1	1	181	0.01	1.75	57	1302	0.044
	324	American Robin	TUMI1	2	25	0.08	3.51	57	1302	0.044
	212	American Tree Sparrow	SPAR1	7	105	0.07	100.00	7	1302	0.005
	30	Barn Swallow	HIRU1	15	107	0.14	27.78	54	1302	0.041
	54	Barn Swallow	HIRU1	5	112	0.04	9.26	54	1302	0.041
	110	Barn Swallow	HIRU1	23	301	0.08	42.59	54	1302	0.041
	212	Barn Swallow	HIRU1	3	105	0.03	5.56	54	1302	0.041
	322	Barn Swallow	HIRU1	6	181	0.03	11.11	54	1302	0.041
	324	Barn Swallow	HIRU1	1	25	0.04	1.85	54	1302	0.041
	540	Barn Swallow	HIRU1	1	2	0.50	1.85	54	1302	0.041
	10	Black-billed Magpie	PIPI1	2	37	0.05	6.90	29	1302	0.022
	20	Black-billed Magpie	PIPI1	2	104	0.02	6.90	29	1302	0.022
	110	Black-billed Magpie	PIPI1	11	301	0.04	37.93	29	1302	0.022
	212	Black-billed Magpie	PIPI1	2	105	0.02	6.90	29	1302	0.022
	230	Black-billed Magpie	PIPI1	12	147	0.08	41.38	29	1302	0.022
	110	Black-capped Chickadee	PAAT1	2	301	0.01	25.00	8	1302	0.006
	230	Black-capped Chickadee	PAAT1	6	147	0.04	75.00	8	1302	0.006
	110	Blue-gray Gnatcatcher	POCA2	5	301	0.02	83.33	6	1302	0.005
	212	Blue-gray Gnatcatcher	POCA2	1	105	0.01	16.67	6	1302	0.005
	110	Brewer's Blackbird	EUCY1	1	301	0.00	33.33	3	1302	0.002
	212	Brewer's Blackbird	EUCY1	2	105	0.02	66.67	3	1302	0.002
	322	Brewer's Sparrow	SPBR1	3	181	0.02	60.00	5	1302	0.004
	323	Brewer's Sparrow	SPBR1	2	139	0.01	40.00	5	1302	0.004

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring (cont.)	110	Brown-headed Cowbird	MOAT1	18	301	0.06	90.00	20	1302	0.015
	212	Brown-headed Cowbird	MOAT1	2	105	0.02	10.00	20	1302	0.015
	30	Cliff Swallow	HIPY1	6	107	0.06	50.00	12	1302	0.009
	54	Cliff Swallow	HIPY1	3	112	0.03	25.00	12	1302	0.009
	110	Cliff Swallow	HIPY1	2	301	0.01	16.67	12	1302	0.009
	322	Cliff Swallow	HIPY1	1	181	0.01	8.33	12	1302	0.009
	323	Common Raven	COCO1	1	139	0.01	100.00	1	1302	0.001
	20	Common Yellowthroat	GETR1	1	104	0.01	5.00	20	1302	0.015
	30	Common Yellowthroat	GETR1	12	107	0.11	60.00	20	1302	0.015
	110	Common Yellowthroat	GETR1	3	301	0.01	15.00	20	1302	0.015
	211	Common Yellowthroat	GETR1	1	26	0.04	5.00	20	1302	0.015
	212	Common Yellowthroat	GETR1	1	105	0.01	5.00	20	1302	0.015
	230	Common Yellowthroat	GETR1	2	147	0.01	10.00	20	1302	0.015
	212	Downy Woodpecker	PIPU1	1	105	0.01	100.00	1	1302	0.001
	540	Eastern Phoebe	SAPH1	1	2	0.50	100.00	1	1302	0.001
	30	European Starling	STVU1	5	107	0.05	6.33	79	1302	0.061
	110	European Starling	STVU1	57	301	0.19	72.15	79	1302	0.061
	322	European Starling	STVU1	13	181	0.07	16.46	79	1302	0.061
	324	European Starling	STVU1	4	25	0.16	5.06	79	1302	0.061
	10	Grasshopper Sparrow	AMSA1	1	37	0.03	10.00	10	1302	0.008
	30	Grasshopper Sparrow	AMSA1	1	107	0.01	10.00	10	1302	0.008
	110	Grasshopper Sparrow	AMSA1	1	301	0.00	10.00	10	1302	0.008
	230	Grasshopper Sparrow	AMSA1	2	147	0.01	20.00	10	1302	0.008
	322	Grasshopper Sparrow	AMSA1	2	181	0.01	20.00	10	1302	0.008
	323	Grasshopper Sparrow	AMSA1	3	139	0.02	30.00	10	1302	0.008
	212	Gray Catbird	DUCA1	1	105	0.01	100.00	1	1302	0.001
	230	Green-tailed Towhee	PICH1	3	147	0.02	100.00	3	1302	0.002
	323	Horned Lark	ERAL1	3	139	0.02	100.00	3	1302	0.002
	110	House Finch	CAME2	22	301	0.07	44.90	49	1302	0.038
	212	House Finch	CAME2	2	105	0.02	4.08	49	1302	0.038
	230	House Finch	CAME2	5	147	0.03	10.20	49	1302	0.038
	322	House Finch	CAME2	4	181	0.02	8.16	49	1302	0.038

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring (cont.)	323	House Finch	CAME2	2	139	0.01	4.08	49	1302	0.038
	324	House Finch	CAME2	14	25	0.56	28.57	49	1302	0.038
	110	House Wren	TRAE1	5	301	0.02	71.43	7	1302	0.005
	230	House Wren	TRAE1	2	147	0.01	28.57	7	1302	0.005
	110	Mountain Bluebird	SICU1	7	301	0.02	77.78	9	1302	0.007
	322	Mountain Bluebird	SICU1	2	181	0.01	22.22	9	1302	0.007
	10	Mourning Dove	ZEMA1	2	37	0.05	4.65	43	1302	0.033
	20	Mourning Dove	ZEMA1	1	104	0.01	2.33	43	1302	0.033
	30	Mourning Dove	ZEMA1	4	107	0.04	9.30	43	1302	0.033
	110	Mourning Dove	ZEMA1	28	301	0.09	65.12	43	1302	0.033
	212	Mourning Dove	ZEMA1	4	105	0.04	9.30	43	1302	0.033
	322	Mourning Dove	ZEMA1	1	181	0.01	2.33	43	1302	0.033
	323	Mourning Dove	ZEMA1	3	139	0.02	6.98	43	1302	0.033
	110	Northern Flicker	COAU1	8	301	0.03	88.89	9	1302	0.007
	212	Northern Flicker	COAU1	1	105	0.01	11.11	9	1302	0.007
	230	Northern mockingbird	MIPO1	1	147	0.01	100.00	1	1302	0.001
	110	Northern Oriole	ICGA1	13	301	0.04	61.90	21	1302	0.016
	212	Northern Oriole	ICGA1	2	105	0.02	9.52	21	1302	0.016
	230	Northern Oriole	ICGA1	6	147	0.04	28.57	21	1302	0.016
	230	Orange-crowned warbler	VECE1	4	147	0.03	100.00	4	1302	0.003
	10	Red-winged Blackbird	AGPH1	9	37	0.24	2.90	310	1302	0.238
	20	Red-winged Blackbird	AGPH1	36	104	0.35	11.61	310	1302	0.238
	30	Red-winged Blackbird	AGPH1	183	107	1.71	59.03	310	1302	0.238
	93	Red-winged Blackbird	AGPH1	1	6	0.17	0.32	310	1302	0.238
	110	Red-winged Blackbird	AGPH1	45	301	0.15	14.52	310	1302	0.238
	211	Red-winged Blackbird	AGPH1	5	26	0.19	1.61	310	1302	0.238
	212	Red-winged Blackbird	AGPH1	27	105	0.26	8.71	310	1302	0.238
	230	Red-winged Blackbird	AGPH1	4	147	0.03	1.29	310	1302	0.238
	322	Rock Wren	SAOB1	1	181	0.01	100.00	1	1302	0.001
	30	Rufous-sided Towhee	PIER1	1	107	0.01	3.23	31	1302	0.024
	110	Rufous-sided Towhee	PIER1	2	301	0.01	6.45	31	1302	0.024
	230	Rufous-sided Towhee	PIER1	28	147	0.19	90.32	31	1302	0.024

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring (cont.)	212	Sage Thrasher	ORMO1	1	105	0.01	25.00	4	1302	0.003
	230	Sage Thrasher	ORMO1	1	147	0.01	25.00	4	1302	0.003
	322	Sage Thrasher	ORMO1	2	181	0.01	50.00	4	1302	0.003
	30	Say's Phoebe	SASA1	2	107	0.02	25.00	8	1302	0.006
	110	Say's Phoebe	SASA1	3	301	0.01	37.50	8	1302	0.006
	230	Say's Phoebe	SASA1	1	147	0.01	12.50	8	1302	0.006
	324	Say's Phoebe	SASA1	2	25	0.08	25.00	8	1302	0.006
	10	Song Sparrow	MEME2	1	37	0.03	1.28	78	1302	0.060
	20	Song Sparrow	MEME2	8	104	0.08	10.26	78	1302	0.060
	30	Song Sparrow	MEME2	15	107	0.14	19.23	78	1302	0.060
	54	Song Sparrow	MEME2	1	112	0.01	1.28	78	1302	0.060
	110	Song Sparrow	MEME2	17	301	0.06	21.79	78	1302	0.060
	212	Song Sparrow	MEME2	6	105	0.06	7.69	78	1302	0.060
	230	Song Sparrow	MEME2	30	147	0.20	38.46	78	1302	0.060
	10	Vesper Sparrow	POGR1	1	37	0.03	0.66	152	1302	0.117
	20	Vesper Sparrow	POGR1	5	104	0.05	3.29	152	1302	0.117
	110	Vesper Sparrow	POGR1	12	301	0.04	7.89	152	1302	0.117
	211	Vesper Sparrow	POGR1	2	26	0.08	1.32	152	1302	0.117
	212	Vesper Sparrow	POGR1	1	105	0.01	0.66	152	1302	0.117
	230	Vesper Sparrow	POGR1	23	147	0.16	15.13	152	1302	0.117
	322	Vesper Sparrow	POGR1	41	181	0.23	26.97	152	1302	0.117
	323	Vesper Sparrow	POGR1	52	139	0.37	34.21	152	1302	0.117
	324	Vesper Sparrow	POGR1	12	25	0.48	7.89	152	1302	0.117
	540	Vesper Sparrow	POGR1	3	2	1.50	1.97	152	1302	0.117
	30	Violet-green Swallow	TATH1	3	107	0.03	100.00	3	1302	0.002
	110	Western Kingbird	TYVE1	4	301	0.01	57.14	7	1302	0.005
	212	Western Kingbird	TYVE1	1	105	0.01	14.29	7	1302	0.005
	322	Western Kingbird	TYVE1	2	181	0.01	28.57	7	1302	0.005
	10	Western Meadowlark	STNE1	9	37	0.24	3.45	261	1302	0.200
	20	Western Meadowlark	STNE1	12	104	0.12	4.60	261	1302	0.200
	30	Western Meadowlark	STNE1	16	107	0.15	6.13	261	1302	0.200
	110	Western Meadowlark	STNE1	39	301	0.13	14.94	261	1302	0.200

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Spring (cont.)	211	Western Meadowlark	STNE1	11	26	0.42	4.21	261	1302	0.200
	212	Western Meadowlark	STNE1	13	105	0.12	4.98	261	1302	0.200
	230	Western Meadowlark	STNE1	29	147	0.20	11.11	261	1302	0.200
	322	Western Meadowlark	STNE1	64	181	0.35	24.52	261	1302	0.200
	323	Western Meadowlark	STNE1	62	139	0.45	23.75	261	1302	0.200
	324	Western Meadowlark	STNE1	4	25	0.16	1.53	261	1302	0.200
	420	Western Meadowlark	STNE1	2	6	0.33	0.77	261	1302	0.200
	110	White-crowned Sparrow	ZOLE1	16	301	0.05	38.10	42	1302	0.032
	212	White-crowned Sparrow	ZOLE1	1	105	0.01	2.38	42	1302	0.032
	230	White-crowned Sparrow	ZOLE1	24	147	0.16	57.14	42	1302	0.032
	322	White-crowned Sparrow	ZOLE1	1	181	0.01	2.38	42	1302	0.032
	110	Yellow Warbler	DEPE1	13	301	0.04	86.67	15	1302	0.012
	230	Yellow Warbler	DEPE1	2	147	0.01	13.33	15	1302	0.012
	30	Yellow-headed Blackbird	XAXA1	32	107	0.30	100.00	32	1302	0.025
	110	Yellow-rumped Warbler	DECO1	17	301	0.06	70.83	24	1302	0.018
	212	Yellow-rumped Warbler	DECO1	7	105	0.07	29.17	24	1302	0.018
Summer	10	American Goldfinch	CATR1	2	59	0.03	1.33	150	1547	0.097
	20	American Goldfinch	CATR1	7	98	0.07	4.67	150	1547	0.097
	110	American Goldfinch	CATR1	68	411	0.17	45.33	150	1547	0.097
	211	American Goldfinch	CATR1	1	46	0.02	0.67	150	1547	0.097
	212	American Goldfinch	CATR1	7	124	0.06	4.67	150	1547	0.097
	230	American Goldfinch	CATR1	62	202	0.31	41.33	150	1547	0.097
	323	American Goldfinch	CATR1	3	159	0.02	2.00	150	1547	0.097
	110	American redstart	SERU2	2	411	0.00	100.00	2	1547	0.001
	30	American Robin	TUMI1	1	109	0.01	2.08	48	1547	0.031
	110	American Robin	TUMI1	20	411	0.05	41.67	48	1547	0.031
	120	American Robin	TUMI1	2	2	1.00	4.17	48	1547	0.031
	212	American Robin	TUMI1	1	124	0.01	2.08	48	1547	0.031
	230	American Robin	TUMI1	23	202	0.11	47.92	48	1547	0.031
	322	American Robin	TUMI1	1	159	0.01	2.08	48	1547	0.031
	20	Barn Swallow	HIRU1	8	98	0.08	5.13	156	1547	0.101

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	30	Barn Swallow	HIRU1	18	109	0.17	11.54	156	1547	0.101
	54	Barn Swallow	HIRU1	4	104	0.04	2.56	156	1547	0.101
	93	Barn Swallow	HIRU1	3	39	0.08	1.92	156	1547	0.101
	110	Barn Swallow	HIRU1	34	411	0.08	21.79	156	1547	0.101
	211	Barn Swallow	HIRU1	4	46	0.09	2.56	156	1547	0.101
	212	Barn Swallow	HIRU1	38	124	0.31	24.36	156	1547	0.101
	230	Barn Swallow	HIRU1	15	202	0.07	9.62	156	1547	0.101
	322	Barn Swallow	HIRU1	19	159	0.12	12.18	156	1547	0.101
	324	Barn Swallow	HIRU1	4	23	0.17	2.56	156	1547	0.101
	420	Barn Swallow	HIRU1	5	3	1.67	3.21	156	1547	0.101
	520	Barn Swallow	HIRU1	2	1	2.00	1.28	156	1547	0.101
	540	Barn Swallow	HIRU1	2	5	0.40	1.28	156	1547	0.101
	54	Belted Kingfisher	CEAL1	1	104	0.01	100.00	1	1547	0.001
	10	Black-billed Magpie	PIPI1	1	59	0.02	2.50	40	1547	0.026
	93	Black-billed Magpie	PIPI1	1	39	0.03	2.50	40	1547	0.026
	110	Black-billed Magpie	PIPI1	6	411	0.01	15.00	40	1547	0.026
	212	Black-billed Magpie	PIPI1	5	124	0.04	12.50	40	1547	0.026
	230	Black-billed Magpie	PIPI1	24	202	0.12	60.00	40	1547	0.026
	322	Black-billed Magpie	PIPI1	2	159	0.01	5.00	40	1547	0.026
	420	Black-billed Magpie	PIPI1	1	3	0.33	2.50	40	1547	0.026
	110	Black-capped Chickadee	PAAT1	3	411	0.01	15.00	20	1547	0.013
	230	Black-capped Chickadee	PAAT1	17	202	0.08	85.00	20	1547	0.013
	230	Black-headed Grosbeak	PHME1	1	202	0.00	100.00	1	1547	0.001
	30	Blue Grosbeak	GUCA1	1	109	0.01	3.33	30	1547	0.019
	110	Blue Grosbeak	GUCA1	15	411	0.04	50.00	30	1547	0.019
	211	Blue Grosbeak	GUCA1	3	46	0.07	10.00	30	1547	0.019
	212	Blue Grosbeak	GUCA1	8	124	0.06	26.67	30	1547	0.019
	230	Blue Grosbeak	GUCA1	3	202	0.01	10.00	30	1547	0.019
	30	Brewer's Blackbird	EUCY1	1	109	0.01	3.23	31	1547	0.020
	93	Brewer's Blackbird	EUCY1	2	39	0.05	6.45	31	1547	0.020
	110	Brewer's Blackbird	EUCY1	25	411	0.06	80.65	31	1547	0.020
	212	Brewer's Blackbird	EUCY1	2	124	0.02	6.45	31	1547	0.020

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	230	Brewer's Blackbird	EUCY1	1	202	0.00	3.23	31	1547	0.020
	30	Broad-tailed Hummingbird	SEPL1	2	109	0.02	66.67	3	1547	0.002
	110	Broad-tailed Hummingbird	SEPL1	1	411	0.00	33.33	3	1547	0.002
	20	Brown-headed Cowbird	MOAT1	2	98	0.02	4.76	42	1547	0.027
	30	Brown-headed Cowbird	MOAT1	2	109	0.02	4.76	42	1547	0.027
	110	Brown-headed Cowbird	MOAT1	16	411	0.04	38.10	42	1547	0.027
	212	Brown-headed Cowbird	MOAT1	3	124	0.02	7.14	42	1547	0.027
	230	Brown-headed Cowbird	MOAT1	18	202	0.09	42.86	42	1547	0.027
	322	Brown-headed Cowbird	MOAT1	1	159	0.01	2.38	42	1547	0.027
	20	Cliff Swallow	HIPY1	1	98	0.01	1.45	69	1547	0.045
	30	Cliff Swallow	HIPY1	20	109	0.18	28.99	69	1547	0.045
	54	Cliff Swallow	HIPY1	8	104	0.08	11.59	69	1547	0.045
	93	Cliff Swallow	HIPY1	5	39	0.13	7.25	69	1547	0.045
	110	Cliff Swallow	HIPY1	10	411	0.02	14.49	69	1547	0.045
	212	Cliff Swallow	HIPY1	5	124	0.04	7.25	69	1547	0.045
	230	Cliff Swallow	HIPY1	16	202	0.08	23.19	69	1547	0.045
	323	Cliff Swallow	HIPY1	4	159	0.03	5.80	69	1547	0.045
	324	Common Grackle	QUQU1	5	23	0.22	100.00	5	1547	0.003
	324	Common Nighthawk	CHMI1	1	23	0.04	100.00	1	1547	0.001
	230	Common Raven	COCO1	2	202	0.01	100.00	2	1547	0.001
	10	Common Yellowthroat	GETR1	2	59	0.03	3.33	60	1547	0.039
	20	Common Yellowthroat	GETR1	8	98	0.08	13.33	60	1547	0.039
	30	Common Yellowthroat	GETR1	20	109	0.18	33.33	60	1547	0.039
	110	Common Yellowthroat	GETR1	15	411	0.04	25.00	60	1547	0.039
	211	Common Yellowthroat	GETR1	4	46	0.09	6.67	60	1547	0.039
	212	Common Yellowthroat	GETR1	7	124	0.06	11.67	60	1547	0.039
	230	Common Yellowthroat	GETR1	4	202	0.02	6.67	60	1547	0.039
	110	Eastern Kingbird	TYTY1	3	411	0.01	60.00	5	1547	0.003
	212	Eastern Kingbird	TYTY1	1	124	0.01	20.00	5	1547	0.003
	322	Eastern Kingbird	TYTY1	1	159	0.01	20.00	5	1547	0.003
	93	Eastern Phoebe	SAPH1	1	39	0.03	7.14	14	1547	0.009
	110	Eastern Phoebe	SAPH1	10	411	0.02	71.43	14	1547	0.009

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	230	Eastern Phoebe	SAPH1	2	202	0.01	14.29	14	1547	0.009
	323	Eastern Phoebe	SAPH1	1	159	0.01	7.14	14	1547	0.009
	10	European Starling	STVU1	2	59	0.03	1.27	158	1547	0.102
	20	European Starling	STVU1	7	98	0.07	4.43	158	1547	0.102
	110	European Starling	STVU1	138	411	0.34	87.34	158	1547	0.102
	211	European Starling	STVU1	1	46	0.02	0.63	158	1547	0.102
	212	European Starling	STVU1	4	124	0.03	2.53	158	1547	0.102
	230	European Starling	STVU1	1	202	0.00	0.63	158	1547	0.102
	322	European Starling	STVU1	2	159	0.01	1.27	158	1547	0.102
	324	European Starling	STVU1	3	23	0.13	1.90	158	1547	0.102
	10	Grasshopper Sparrow	AMSA1	3	59	0.05	9.38	32	1547	0.021
	30	Grasshopper Sparrow	AMSA1	2	109	0.02	6.25	32	1547	0.021
	110	Grasshopper Sparrow	AMSA1	3	411	0.01	9.38	32	1547	0.021
	211	Grasshopper Sparrow	AMSA1	2	46	0.04	6.25	32	1547	0.021
	212	Grasshopper Sparrow	AMSA1	1	124	0.01	3.13	32	1547	0.021
	322	Grasshopper Sparrow	AMSA1	12	159	0.08	37.50	32	1547	0.021
	323	Grasshopper Sparrow	AMSA1	9	159	0.06	28.13	32	1547	0.021
	230	Green-tailed Towhee	PICH1	12	202	0.06	100.00	12	1547	0.008
	323	Horned Lark	ERAL1	6	159	0.04	100.00	6	1547	0.004
	10	House Finch	CAME2	5	59	0.08	1.43	350	1547	0.226
	20	House Finch	CAME2	12	98	0.12	3.43	350	1547	0.226
	30	House Finch	CAME2	8	109	0.07	2.29	350	1547	0.226
	110	House Finch	CAME2	139	411	0.34	39.71	350	1547	0.226
	120	House Finch	CAME2	2	2	1.00	0.57	350	1547	0.226
	211	House Finch	CAME2	7	46	0.15	2.00	350	1547	0.226
	212	House Finch	CAME2	39	124	0.31	11.14	350	1547	0.226
	230	House Finch	CAME2	64	202	0.32	18.29	350	1547	0.226
	322	House Finch	CAME2	19	159	0.12	5.43	350	1547	0.226
	324	House Finch	CAME2	26	23	1.13	7.43	350	1547	0.226
	420	House Finch	CAME2	10	3	3.33	2.86	350	1547	0.226
	540	House Finch	CAME2	19	5	3.80	5.43	350	1547	0.226
	110	House Wren	TRAE1	8	411	0.02	72.73	11	1547	0.007

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	120	House Wren	TRAE1	1	2	0.50	9.09	11	1547	0.007
	230	House Wren	TRAE1	2	202	0.01	18.18	11	1547	0.007
	110	Lesser Goldfinch	CAPS1	10	411	0.02	83.33	12	1547	0.008
	230	Lesser Goldfinch	CAPS1	2	202	0.01	16.67	12	1547	0.008
	110	Loggerhead Shrike	LALU1	1	411	0.00	50.00	2	1547	0.001
	322	Loggerhead Shrike	LALU1	1	159	0.01	50.00	2	1547	0.001
	20	Mourning Dove	ZEMA1	5	98	0.05	3.60	139	1547	0.090
	30	Mourning Dove	ZEMA1	10	109	0.09	7.19	139	1547	0.090
	110	Mourning Dove	ZEMA1	98	411	0.24	70.50	139	1547	0.090
	211	Mourning Dove	ZEMA1	4	46	0.09	2.88	139	1547	0.090
	212	Mourning Dove	ZEMA1	5	124	0.04	3.60	139	1547	0.090
	230	Mourning Dove	ZEMA1	6	202	0.03	4.32	139	1547	0.090
	322	Mourning Dove	ZEMA1	1	159	0.01	0.72	139	1547	0.090
	323	Mourning Dove	ZEMA1	4	159	0.03	2.88	139	1547	0.090
	324	Mourning Dove	ZEMA1	1	23	0.04	0.72	139	1547	0.090
	420	Mourning Dove	ZEMA1	1	3	0.33	0.72	139	1547	0.090
	530	Mourning Dove	ZEMA1	4	3	1.33	2.88	139	1547	0.090
	20	Northern Flicker	COAU1	1	98	0.01	25.00	4	1547	0.003
	110	Northern Flicker	COAU1	2	411	0.00	50.00	4	1547	0.003
	212	Northern Flicker	COAU1	1	124	0.01	25.00	4	1547	0.003
	20	Northern Oriole	ICGA1	1	98	0.01	1.18	85	1547	0.055
	110	Northern Oriole	ICGA1	47	411	0.11	55.29	85	1547	0.055
	211	Northern Oriole	ICGA1	4	46	0.09	4.71	85	1547	0.055
	212	Northern Oriole	ICGA1	17	124	0.14	20.00	85	1547	0.055
	230	Northern Oriole	ICGA1	15	202	0.07	17.65	85	1547	0.055
	322	Northern Oriole	ICGA1	1	159	0.01	1.18	85	1547	0.055
	20	Pine Siskin	CAPI1	2	98	0.02	100.00	2	1547	0.001
	120	Red-breasted Nuthatch	SICA2	1	2	0.50	100.00	1	1547	0.001
	10	Red-winged Blackbird	AGPH1	11	59	0.19	2.01	546	1547	0.353
	20	Red-winged Blackbird	AGPH1	75	98	0.77	13.74	546	1547	0.353
	30	Red-winged Blackbird	AGPH1	192	109	1.76	35.16	546	1547	0.353
	93	Red-winged Blackbird	AGPH1	21	39	0.54	3.85	546	1547	0.353

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	110	Red-winged Blackbird	AGPH1	50	411	0.12	9.16	546	1547	0.353
	211	Red-winged Blackbird	AGPH1	5	46	0.11	0.92	546	1547	0.353
	212	Red-winged Blackbird	AGPH1	97	124	0.78	17.77	546	1547	0.353
	230	Red-winged Blackbird	AGPH1	75	202	0.37	13.74	546	1547	0.353
	322	Red-winged Blackbird	AGPH1	5	159	0.03	0.92	546	1547	0.353
	324	Red-winged Blackbird	AGPH1	15	23	0.65	2.75	546	1547	0.353
	230	Rock Wren	SAOB1	2	202	0.01	66.67	3	1547	0.002
	322	Rock Wren	SAOB1	1	159	0.01	33.33	3	1547	0.002
	110	Rufous-sided Towhee	PIER1	1	411	0.00	1.49	67	1547	0.043
	230	Rufous-sided Towhee	PIER1	66	202	0.33	98.51	67	1547	0.043
	30	Say's Phoebe	SASA1	2	109	0.02	10.53	19	1547	0.012
	110	Say's Phoebe	SASA1	9	411	0.02	47.37	19	1547	0.012
	211	Say's Phoebe	SASA1	1	46	0.02	5.26	19	1547	0.012
	212	Say's Phoebe	SASA1	2	124	0.02	10.53	19	1547	0.012
	230	Say's Phoebe	SASA1	2	202	0.01	10.53	19	1547	0.012
	324	Say's Phoebe	SASA1	2	23	0.09	10.53	19	1547	0.012
	420	Say's Phoebe	SASA1	1	3	0.33	5.26	19	1547	0.012
	10	Song Sparrow	MEME2	2	59	0.03	2.41	83	1547	0.054
	20	Song Sparrow	MEME2	8	98	0.08	9.64	83	1547	0.054
	30	Song Sparrow	MEME2	13	109	0.12	15.66	83	1547	0.054
	110	Song Sparrow	MEME2	30	411	0.07	36.14	83	1547	0.054
	212	Song Sparrow	MEME2	3	124	0.02	3.61	83	1547	0.054
	230	Song Sparrow	MEME2	27	202	0.13	32.53	83	1547	0.054
	10	Vesper Sparrow	POGR1	4	59	0.07	1.39	287	1547	0.186
	20	Vesper Sparrow	POGR1	19	98	0.19	6.62	287	1547	0.186
	30	Vesper Sparrow	POGR1	4	109	0.04	1.39	287	1547	0.186
	93	Vesper Sparrow	POGR1	4	39	0.10	1.39	287	1547	0.186
	110	Vesper Sparrow	POGR1	36	411	0.09	12.54	287	1547	0.186
	211	Vesper Sparrow	POGR1	18	46	0.39	6.27	287	1547	0.186
	212	Vesper Sparrow	POGR1	10	124	0.08	3.48	287	1547	0.186
	230	Vesper Sparrow	POGR1	23	202	0.11	8.01	287	1547	0.186
	322	Vesper Sparrow	POGR1	44	159	0.28	15.33	287	1547	0.186

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Summer (cont.)	323	Vesper Sparrow	POGR1	103	159	0.65	35.89	287	1547	0.186
	324	Vesper Sparrow	POGR1	9	23	0.39	3.14	287	1547	0.186
	420	Vesper Sparrow	POGR1	9	3	3.00	3.14	287	1547	0.186
	540	Vesper Sparrow	POGR1	4	5	0.80	1.39	287	1547	0.186
	110	Virginia's Warbler	VEVI1	4	411	0.01	80.00	5	1547	0.003
	230	Virginia's Warbler	VEVI1	1	202	0.00	20.00	5	1547	0.003
	110	Western Kingbird	TYVE1	18	411	0.04	58.06	31	1547	0.020
	212	Western Kingbird	TYVE1	5	124	0.04	16.13	31	1547	0.020
	230	Western Kingbird	TYVE1	5	202	0.02	16.13	31	1547	0.020
	322	Western Kingbird	TYVE1	3	159	0.02	9.68	31	1547	0.020
	10	Western Meadowlark	STNE1	8	59	0.14	3.13	256	1547	0.165
	20	Western Meadowlark	STNE1	12	98	0.12	4.69	256	1547	0.165
	30	Western Meadowlark	STNE1	13	109	0.12	5.08	256	1547	0.165
	93	Western Meadowlark	STNE1	1	39	0.03	0.39	256	1547	0.165
	110	Western Meadowlark	STNE1	84	411	0.20	32.81	256	1547	0.165
	211	Western Meadowlark	STNE1	15	46	0.33	5.86	256	1547	0.165
	212	Western Meadowlark	STNE1	13	124	0.10	5.08	256	1547	0.165
	230	Western Meadowlark	STNE1	32	202	0.16	12.50	256	1547	0.165
	322	Western Meadowlark	STNE1	52	159	0.33	20.31	256	1547	0.165
	323	Western Meadowlark	STNE1	22	159	0.14	8.59	256	1547	0.165
	324	Western Meadowlark	STNE1	4	23	0.17	1.56	256	1547	0.165
	110	Western Wood-Pewee	COSO1	1	411	0.00	33.33	3	1547	0.002
	230	Western Wood-Pewee	COSO1	2	202	0.01	66.67	3	1547	0.002
	110	Yellow Warbler	DEPE1	30	411	0.07	75.00	40	1547	0.026
	212	Yellow Warbler	DEPE1	4	124	0.03	10.00	40	1547	0.026
	230	Yellow Warbler	DEPE1	6	202	0.03	15.00	40	1547	0.026
	110	Yellow-breasted Chat	ICVI1	2	411	0.00	16.67	12	1547	0.008
	230	Yellow-breasted Chat	ICVI1	10	202	0.05	83.33	12	1547	0.008
	30	Yellow-headed Blackbird	XAXA1	44	109	0.40	97.78	45	1547	0.029
	110	Yellow-headed Blackbird	XAXA1	1	411	0.00	2.22	45	1547	0.029
Fall	110	American Goldfinch	CATR1	6	323	0.02	46.15	13	1356	0.010

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Fall (cont.)	230	American Goldfinch	CATR1	7	186	0.04	53.85	13	1356	0.010
	110	American Robin	TUMI1	3	323	0.01	42.86	7	1356	0.005
	230	American Robin	TUMI1	4	186	0.02	57.14	7	1356	0.005
	30	American Tree Sparrow	SPAR1	6	125	0.05	17.14	35	1356	0.026
	110	American Tree Sparrow	SPAR1	16	323	0.05	45.71	35	1356	0.026
	211	American Tree Sparrow	SPAR1	8	31	0.26	22.86	35	1356	0.026
	212	American Tree Sparrow	SPAR1	5	164	0.03	14.29	35	1356	0.026
	110	Ash-throated Flycatcher	MYCI1	1	323	0.00	100.00	1	1356	0.001
	30	Barn Swallow	HIRU1	26	125	0.21	76.47	34	1356	0.025
	110	Barn Swallow	HIRU1	3	323	0.01	8.82	34	1356	0.025
	212	Barn Swallow	HIRU1	1	164	0.01	2.94	34	1356	0.025
	322	Barn Swallow	HIRU1	3	133	0.02	8.82	34	1356	0.025
	540	Barn Swallow	HIRU1	1	11	0.09	2.94	34	1356	0.025
	30	Belted Kingfisher	CEAL1	1	125	0.01	50.00	2	1356	0.001
	110	Belted Kingfisher	CEAL1	1	323	0.00	50.00	2	1356	0.001
	10	Black-billed Magpie	PIPI1	1	45	0.02	1.23	81	1356	0.060
	20	Black-billed Magpie	PIPI1	1	87	0.01	1.23	81	1356	0.060
	110	Black-billed Magpie	PIPI1	55	323	0.17	67.90	81	1356	0.060
	212	Black-billed Magpie	PIPI1	12	164	0.07	14.81	81	1356	0.060
	230	Black-billed Magpie	PIPI1	9	186	0.05	11.11	81	1356	0.060
	322	Black-billed Magpie	PIPI1	3	133	0.02	3.70	81	1356	0.060
	110	Black-capped Chickadee	PAAT1	1	323	0.00	8.33	12	1356	0.009
	230	Black-capped Chickadee	PAAT1	11	186	0.06	91.67	12	1356	0.009
	212	Blue Grosbeak	GUCA1	2	164	0.01	100.00	2	1356	0.001
	110	Blue Jay	CYCR1	1	323	0.00	100.00	1	1356	0.001
	110	Blue-gray Gnatcatcher	POCA2	1	323	0.00	100.00	1	1356	0.001
	110	Chipping Sparrow	SPPA1	2	323	0.01	20.00	10	1356	0.007
	212	Chipping Sparrow	SPPA1	2	164	0.01	20.00	10	1356	0.007
	230	Chipping Sparrow	SPPA1	6	186	0.03	60.00	10	1356	0.007
	110	Common Nighthawk	CHMI1	1	323	0.00	100.00	1	1356	0.001
	20	Common Yellowthroat	GETR1	1	87	0.01	25.00	4	1356	0.003
	30	Common Yellowthroat	GETR1	1	125	0.01	25.00	4	1356	0.003

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Fall (cont.)	110	Common Yellowthroat	GETR1	1	323	0.00	25.00	4	1356	0.003
	212	Common Yellowthroat	GETR1	1	164	0.01	25.00	4	1356	0.003
	20	Dark-eyed Junco	JUHY1	1	87	0.01	100.00	1	1356	0.001
	110	Eastern Phoebe	SAPH1	1	323	0.00	100.00	1	1356	0.001
	30	Grasshopper Sparrow	AMSA1	1	125	0.01	50.00	2	1356	0.001
	323	Grasshopper Sparrow	AMSA1	1	129	0.01	50.00	2	1356	0.001
	10	Hairy Woodpecker	PIV11	1	4	0.25	100.00	1	1356	0.001
	323	Horned Lark	ERAL1	1	129	0.01	100.00	1	1356	0.001
	10	House Finch	CAME2	3	45	0.07	3.61	83	1356	0.061
	20	House Finch	CAME2	1	87	0.01	1.20	83	1356	0.061
	30	House Finch	CAME2	4	125	0.03	4.82	83	1356	0.061
	110	House Finch	CAME2	23	323	0.07	27.71	83	1356	0.061
	211	House Finch	CAME2	1	31	0.03	1.20	83	1356	0.061
	212	House Finch	CAME2	16	164	0.10	19.28	83	1356	0.061
	230	House Finch	CAME2	28	186	0.15	33.73	83	1356	0.061
	322	House Finch	CAME2	3	133	0.02	3.61	83	1356	0.061
	540	House Finch	CAME2	4	11	0.36	4.82	83	1356	0.061
	20	Loggerhead Shrike	LALU1	1	87	0.01	50.00	2	1356	0.001
	230	Loggerhead Shrike	LALU1	1	186	0.01	50.00	2	1356	0.001
	30	Marsh Wren	CIPA1	3	125	0.02	100.00	3	1356	0.002
	230	Mountain Bluebird	SICU1	6	186	0.03	66.67	9	1356	0.007
	323	Mountain Bluebird	SICU1	3	129	0.02	33.33	9	1356	0.007
	20	Northern Flicker	COAU1	1	87	0.01	4.17	24	1356	0.018
	110	Northern Flicker	COAU1	20	323	0.06	83.33	24	1356	0.018
	212	Northern Flicker	COAU1	1	164	0.01	4.17	24	1356	0.018
	230	Northern Flicker	COAU1	2	186	0.01	8.33	24	1356	0.018
	30	Red-winged Blackbird	AGPH1	15	125	0.12	71.43	21	1356	0.015
	110	Red-winged Blackbird	AGPH1	6	323	0.02	28.57	21	1356	0.015
	110	Rock Dove	COLI1	4	323	0.01	100.00	4	1356	0.003
	322	Rock Wren	SAOB1	5	133	0.04	35.71	14	1356	0.010
	323	Rock Wren	SAOB1	2	129	0.02	14.29	14	1356	0.010
	530	Rock Wren	SAOB1	3	1	3.00	21.43	14	1356	0.010

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Fall (cont.)	540	Rock Wren	SAOB1	4	11	0.36	28.57	14	1356	0.010
	110	Rufous-sided Towhee	PIER1	2	323	0.01	11.76	17	1356	0.013
	230	Rufous-sided Towhee	PIER1	15	186	0.08	88.24	17	1356	0.013
	322	Sage Thrasher	ORMO1	1	133	0.01	100.00	1	1356	0.001
	110	Say's Phoebe	SASA1	2	323	0.01	50.00	4	1356	0.003
	212	Say's Phoebe	SASA1	1	164	0.01	25.00	4	1356	0.003
	230	Say's Phoebe	SASA1	1	186	0.01	25.00	4	1356	0.003
	10	Song Sparrow	MEME2	1	45	0.02	2.56	39	1356	0.029
	20	Song Sparrow	MEME2	3	87	0.03	7.69	39	1356	0.029
	30	Song Sparrow	MEME2	11	125	0.09	28.21	39	1356	0.029
	110	Song Sparrow	MEME2	6	323	0.02	15.38	39	1356	0.029
	212	Song Sparrow	MEME2	1	164	0.01	2.56	39	1356	0.029
	230	Song Sparrow	MEME2	17	186	0.09	43.59	39	1356	0.029
	10	Vesper Sparrow	POGR1	1	45	0.02	2.04	49	1356	0.036
	20	Vesper Sparrow	POGR1	1	87	0.01	2.04	49	1356	0.036
	30	Vesper Sparrow	POGR1	1	125	0.01	2.04	49	1356	0.036
	110	Vesper Sparrow	POGR1	2	323	0.01	4.08	49	1356	0.036
	211	Vesper Sparrow	POGR1	4	31	0.13	8.16	49	1356	0.036
	212	Vesper Sparrow	POGR1	2	164	0.01	4.08	49	1356	0.036
	230	Vesper Sparrow	POGR1	5	186	0.03	10.20	49	1356	0.036
	322	Vesper Sparrow	POGR1	11	133	0.08	22.45	49	1356	0.036
	323	Vesper Sparrow	POGR1	18	129	0.14	36.73	49	1356	0.036
	530	Vesper Sparrow	POGR1	1	1	1.00	2.04	49	1356	0.036
	540	Vesper Sparrow	POGR1	3	11	0.27	6.12	49	1356	0.036
	110	Virginia's Warbler	VEVI1	2	323	0.01	100.00	2	1356	0.001
	110	Western Kingbird	TYVE1	1	323	0.00	100.00	1	1356	0.001
	10	Western Meadowlark	STNE1	5	45	0.11	7.94	63	1356	0.046
	20	Western Meadowlark	STNE1	2	87	0.02	3.17	63	1356	0.046
	110	Western Meadowlark	STNE1	27	323	0.08	42.86	63	1356	0.046
	211	Western Meadowlark	STNE1	4	31	0.13	6.35	63	1356	0.046
	212	Western Meadowlark	STNE1	10	164	0.06	15.87	63	1356	0.046
	230	Western Meadowlark	STNE1	4	186	0.02	6.35	63	1356	0.046

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Fall (cont.)	322	Western Meadowlark	STNE1	3	133	0.02	4.76	63	1356	0.046
	323	Western Meadowlark	STNE1	8	129	0.06	12.70	63	1356	0.046
	30	White-crowned Sparrow	ZOLE1	4	125	0.03	57.14	7	1356	0.005
	110	White-crowned Sparrow	ZOLE1	3	323	0.01	42.86	7	1356	0.005
	110	Wilson's Warbler	WIPU1	1	323	0.00	100.00	1	1356	0.001
Winter	230	American Goldfinch	CATR1	2	136	0.01	100.00	2	1053	0.002
	30	American Tree Sparrow	SPAR1	1	73	0.01	4.35	23	1053	0.022
	110	American Tree Sparrow	SPAR1	3	263	0.01	13.04	23	1053	0.022
	212	American Tree Sparrow	SPAR1	6	63	0.10	26.09	23	1053	0.022
	230	American Tree Sparrow	SPAR1	10	136	0.07	43.48	23	1053	0.022
	420	American Tree Sparrow	SPAR1	3	3	1.00	13.04	23	1053	0.022
	93	Black-billed Magpie	PIPI1	2	3	0.67	2.35	85	1053	0.081
	110	Black-billed Magpie	PIPI1	26	263	0.10	30.59	85	1053	0.081
	212	Black-billed Magpie	PIPI1	13	63	0.21	15.29	85	1053	0.081
	230	Black-billed Magpie	PIPI1	30	136	0.22	35.29	85	1053	0.081
	322	Black-billed Magpie	PIPI1	10	152	0.07	11.76	85	1053	0.081
	324	Black-billed Magpie	PIPI1	1	16	0.06	1.18	85	1053	0.081
	420	Black-billed Magpie	PIPI1	3	3	1.00	3.53	85	1053	0.081
	110	Black-capped Chickadee	PAAT1	2	263	0.01	40.00	5	1053	0.005
	230	Black-capped Chickadee	PAAT1	3	136	0.02	60.00	5	1053	0.005
	230	Downy Woodpecker	PIPU1	1	136	0.01	100.00	1	1053	0.001
	212	European Starling	STVU1	39	63	0.62	92.86	42	1053	0.040
	230	European Starling	STVU1	2	136	0.01	4.76	42	1053	0.040
	322	European Starling	STVU1	1	152	0.01	2.38	42	1053	0.040
	230	Horned Lark	ERAL1	2	136	0.01	8.70	23	1053	0.022
	322	Horned Lark	ERAL1	7	152	0.05	30.43	23	1053	0.022
	323	Horned Lark	ERAL1	14	127	0.11	60.87	23	1053	0.022
	110	House Finch	CAME2	3	263	0.01	75.00	4	1053	0.004
	324	House Finch	CAME2	1	16	0.06	25.00	4	1053	0.004
	110	Northern Flicker	COAU1	15	263	0.06	93.75	16	1053	0.015
	230	Northern Flicker	COAU1	1	136	0.01	6.25	16	1053	0.015

Table 3-17. (cont.)

Season	Habitat	Common Name	Spec Code	No. in Habitat	Total Time	Obs/ Min	Percent Obs/ Season	Total Obs/ Season	Time in Season	Obs/Min for Sp. /Season
Winter (cont.)	30	Red-winged Blackbird	AGPH1	2	73	0.03	8.33	24	1053	0.023
	110	Red-winged Blackbird	AGPH1	21	263	0.08	87.50	24	1053	0.023
	230	Red-winged Blackbird	AGPH1	1	136	0.01	4.17	24	1053	0.023
	30	Song Sparrow	MEME2	2	73	0.03	28.57	7	1053	0.007
	110	Song Sparrow	MEME2	2	263	0.01	28.57	7	1053	0.007
	230	Song Sparrow	MEME2	3	136	0.02	42.86	7	1053	0.007
	322	Western Meadowlark	STNE1	3	152	0.02	50.00	6	1053	0.006
	323	Western Meadowlark	STNE1	3	127	0.02	50.00	6	1053	0.006

Table 3-18. Bird diversity (Simpsons's Index for each season by year and habitat)

Season	Habitat	Survey Year							
		1991	1993	1994	1995	1996	1997	1998	1999
Spring	Grasslands	ND	ND	0.83	0.79	0.76	0.79	0.71	0.72
	Woodland/Shrublands	ND	ND	0.91	0.93	0.94	0.94	0.93	0.94
	Wetlands	ND	ND	0.77	0.77	0.83	0.84	0.71	0.77
Breeding (June only)	Grasslands	0.82	0.78	0.88	0.86	0.80	0.81	0.82	0.80
	Woodland/Shrublands	0.91	0.91	0.94	0.94	0.93	0.93	0.93	0.94
	Wetlands	0.75	0.66	0.68	0.67	0.63	0.62	0.66	0.67
Summer	Grasslands	ND	ND	0.89	0.85	0.83	0.84	0.84	0.84
	Woodland/Shrublands	ND	ND	0.94	0.94	0.93	0.93	0.94	0.94
	Wetlands	ND	ND	0.73	0.73	0.67	0.75	0.73	0.67
Fall	Grasslands	ND	ND	0.73	0.87	0.78	0.76	0.87	0.85
	Woodland/Shrublands	ND	ND	0.95	0.92	0.95	0.92	0.93	0.93
	Wetlands	ND	ND	0.92	0.68	0.91	0.89	0.90	0.89
Winter	Grasslands	0.76	0.80	0.73	0.67	0.37	0.50	0.60	0.87
	Woodland/Shrublands	0.85	0.88	0.87	0.86	0.80	0.76	0.88	0.78
	Wetlands	0.82	0.86	0.62	0.59	0.73	0.66	0.91	0.86
Annual Summary	Diversity Indices per year	0.90	0.88	0.93	0.93	0.93	0.93	0.93	0.93
	Diversity per year in Spring	NA	NA	0.90	0.90	0.91	0.91	0.89	0.90
	Diversity per year in June	0.89	0.87	0.92	0.92	0.92	0.91	0.92	0.92
	Diversity per year in Summer	NA	NA	0.93	0.93	0.92	0.92	0.93	0.93
	Diversity per year in Fall	NA	NA	0.89	0.92	0.94	0.91	0.94	0.93
	Diversity per year in Winter	0.88	0.92	0.88	0.89	0.84	0.83	0.90	0.84

ND = no data collected

NA = not applicable

Table 3-19. Species richness for each season by year and habitat

Season	Habitat	Survey Year							
		1991	1993	1994	1995	1996	1997	1998	1999
Spring	Grasslands	ND	ND	28	25	21	24	20	19
	Woodland/Shrublands	ND	ND	39	48	49	41	37	40
	Wetlands	ND	ND	26	25	23	21	21	22
Breeding (June only)	Grasslands	18	20	34	28	21	24	28	27
	Woodland/Shrublands	38	39	39	47	40	42	44	46
	Wetlands	23	28	26	25	23	21	27	24
Summer	Grasslands	ND	ND	41	30	31	30	33	35
	Woodland/Shrublands	ND	ND	48	52	47	51	52	53
	Wetlands	ND	ND	30	31	28	28	31	28
Fall	Grasslands	ND	ND	20	20	16	11	18	19
	Woodland/Shrublands	ND	ND	36	30	44	24	35	37
	Wetlands	ND	ND	16	14	22	15	18	14
Winter	Grasslands	5	4	9	8	7	7	9	8
	Woodland/Shrublands	11	12	16	14	12	14	18	12
	Wetlands	7	4	5	10	6	3	7	5
Annual Summary	Species Richness per year at 100m	56	56	87	86	96	83	87	85
	Species Richness per year at 50m	49	51	76	75	90	75	85	80
	Richness per year in Spring	NA	NA	50	55	58	48	47	49
	Richness per year in June	43	45	49	49	46	48	53	54
	Richness per year in Summer	NA	NA	60	56	59	59	63	64
	Richness per year in Fall	NA	NA	41	34	46	30	42	44
	Richness per year in Winter	14	14	19	20	18	16	25	15

ND = no data collected

NA = not applicable

Table 3-20. Density ^a of all birds for each season by year and habitat

Season	Habitat	Survey Year							
		1991	1993	1994	1995	1996	1997	1998	1999
Spring	Grasslands	ND	ND	209	183	159	201	173	139
	Woodland/Shrublands	ND	ND	343	359	252	379	339	290
	Wetlands	ND	ND	301	346	291	386	328	312
Breeding (June only)	Grasslands	260	195	332	275	211	218	222	206
	Woodland/Shrublands	567	664	485	372	320	401	435	326
	Wetlands	522	459	571	453	453	552	562	500
Summer	Grasslands	ND	ND	309	238	255	221	206	225
	Woodland/Shrublands	ND	ND	404	369	303	378	394	316
	Wetlands	ND	ND	539	451	477	550	562	513
Fall	Grasslands	ND	ND	152	75	98	93	79	75
	Woodland/Shrublands	ND	ND	106	312	183	69	97	48
	Wetlands	ND	ND	172	281	328	221	270	228
Winter	Grasslands	15	8	46	29	28	110	20	18
	Woodland/Shrublands	21	8	37	50	21	19	11	20
	Wetlands	36	31	81	106	63	261	59	125

ND = no data collected

NA = not applicable

^a Densities are individuals per square kilometer.

Table 3-21. Selected bird densities during June

Common Name	Survey Year							
	1991	1993	1994	1995	1996	1997	1998	1999
Red-winged Blackbird	78.63	93.33	74.71	56.47	47.79	60.44	59.12	50.59
Western Meadowlark	66.47	76.08	60.88	47.94	46.91	60.44	47.06	42.79
Vesper Sparrow	39.61	29.22	41.18	34.26	32.35	36.76	33.82	38.24
European Starling	21.57	3.53	16.18	23.24	26.32	16.76	32.50	26.62
House Finch	66.47	20.78	36.32	19.71	16.32	39.26	29.26	16.18
Song Sparrow	10.59	12.16	25.44	17.50	13.38	14.26	20.29	14.71
Grasshopper Sparrow	8.43	26.67	18.82	14.71	25.74	20.29	26.18	14.41
American Goldfinch	0.00	13.33	22.35	21.03	11.62	16.76	15.29	13.53
Mourning Dove	22.94	8.63	19.26	17.21	12.94	7.94	12.50	13.09
Northern Oriole	10.20	8.43	13.82	7.79	8.09	11.62	9.85	12.65
Brown-headed Cowbird	1.76	2.16	10.88	5.00	4.71	9.41	14.26	11.76
Rufous-sided Towhee	4.31	6.47	11.03	10.59	12.65	14.26	15.44	9.71
Black-billed Magpie	5.29	2.94	7.65	4.71	3.09	5.00	7.65	7.06
Yellow Warbler	2.35	3.92	0.59	2.35	3.68	5.00	4.85	7.06
Common Yellowthroat	2.16	7.45	6.47	9.26	3.97	4.56	5.44	6.62
Common Snipe	1.57	2.94	4.26	2.35	2.21	2.94	3.82	4.71
Western Kingbird	4.31	0.20	3.38	3.82	1.91	2.35	2.06	3.38
Blue Grosbeak	2.16	1.96	2.65	1.03	0.88	2.94	1.76	2.35
Brewer's Blackbird	6.86	14.51	12.94	13.82	3.97	3.53	2.94	2.21
Black-capped Chickadee	0.00	0.00	0.44	2.50	0.29	0.44	1.03	2.21
Yellow-breasted Chat	0.98	0.20	0.15	0.59	1.62	1.91	0.74	1.62

^a Densities are individuals per square kilometer during the month of June.

Table 3-22. Neotropical migrant species richness in June 1991, 1993-1999

Habitat	Survey Year							
	1991	1993	1994	1995	1996	1997	1998	1999
Grasslands	16	15	25	20	14	16	19	20
Woodlands/Shurblands	29	31	29	31	25	27	32	33
Wetlands	14	20	17	19	12	13	18	14

Note: Data from June (breeding season) only.

Table 3-23. Density ^a of neotropical migrant bird species, 1991, 1993 - 1999

Common Name	Survey Year							
	1991	1993	1994	1995	1996	1997	1998	1999
American Goldfinch	9.22	13.33	22.35	21.03	11.62	16.76	15.29	13.53
American Kestrel	0.39	0.20	2.21	0.74	0.00	0.29	0.59	0.88
American Robin	0.78	1.18	1.91	1.32	2.50	1.18	4.71	4.71
Barn Swallow	8.63	11.96	15.44	10.59	5.88	6.62	9.71	5.88
Blue Grosbeak	2.16	1.96	2.65	1.03	0.88	2.94	1.76	2.35
Blue-gray Gnatcatcher	0.00	0.00	0.29	0.00	0.00	0.44	0.00	0.88
Brewer's Blackbird	6.86	14.51	12.94	13.82	3.97	3.53	2.94	2.21
Brewer's Sparrow	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00
Broad-tailed Hummingbird	0.00	0.00	0.00	0.15	0.00	0.29	0.00	0.00
Brown-headed Cowbird	1.76	2.16	10.88	5.00	4.71	9.41	14.26	11.76
Cassin's Finch	0.00	0.00	0.88	0.00	0.00	0.00	0.00	0.00
Chestnut-sided Warbler	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00
Chipping Sparrow	0.00	0.00	0.15	0.00	0.00	0.00	0.15	0.00
Cliff Swallow	0.39	0.39	5.29	2.65	6.62	4.41	5.59	2.79
Common Nighthawk	1.57	3.33	0.59	1.47	1.32	0.59	0.88	0.15
Common Poorwill	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00
Common Yellowthroat	2.16	7.45	6.47	9.26	3.97	4.56	5.44	6.62
Eastern Kingbird	1.76	0.98	1.62	1.32	1.03	0.44	1.62	0.29
Eastern Phoebe	0.00	0.39	0.00	0.44	0.15	0.00	0.15	1.03
Ferruginous Hawk	0.20	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Golden Eagle	0.00	0.00	0.59	0.00	0.00	0.00	0.15	0.15
Grasshopper Sparrow	8.43	26.67	18.82	14.71	25.74	20.29	26.18	14.41
Gray Catbird	0.20	0.00	0.00	0.00	0.00	0.00	0.15	0.15
Green-tailed Towhee	0.39	2.94	1.47	0.29	2.06	1.47	1.32	1.91
House Wren	0.20	0.20	0.15	0.00	0.15	1.32	0.15	1.18
Lazuli Bunting	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lesser Goldfinch	0.20	0.59	1.18	1.32	0.00	1.47	0.15	0.29
Lincoln's Sparrow	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00
Loggerhead Shrike	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00
Marsh Wren	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
Northern Oriole	10.20	8.43	13.82	7.79	8.09	11.62	9.85	12.65
Red-tailed Hawk	4.12	1.18	1.32	1.47	0.88	1.18	1.18	0.88
Red-winged Blackbird	78.63	93.33	74.71	56.47	47.79	60.44	59.12	50.59
Ruby-crowned Kinglet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Rufous Hummingbird	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29
Rufous-sided Towhee	4.31	6.47	11.03	10.59	12.65	14.26	15.44	9.71
Sage Thrasher	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.15
Savannah Sparrow	0.78	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Say's Phoebe	1.37	0.59	1.18	0.74	0.44	0.88	1.18	0.44
Solitary Vireo	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
Swainson's Hawk	0.98	0.39	0.29	0.00	0.00	0.00	0.00	1.18
Swainson's Thrush	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tree Swallow	0.00	0.39	0.15	0.29	0.00	0.00	0.00	0.00
Turkey Vulture	0.00	0.20	0.15	0.00	0.00	0.00	0.15	0.00

Table 3-23. (cont.)

Common Name	Survey Year							
	1991	1993	1994	1995	1996	1997	1998	1999
Vesper Sparrow	39.61	29.22	41.18	34.26	32.35	36.76	33.82	38.24
Violet-green Swallow	0.20	0.00	0.00	0.00	0.00	0.00	0.29	0.00
Warbling Vireo	0.39	0.20	0.15	0.00	0.00	0.00	0.00	0.00
Western Kingbird	4.31	0.20	3.38	3.82	1.91	2.35	2.06	3.38
Western Meadowlark	66.47	76.08	60.88	47.94	46.91	60.44	47.06	42.79
Western Wood-Pewee	0.00	0.00	0.00	0.00	0.29	0.00	0.15	0.15
Willow Flycatcher	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.15
Wilson's Warbler	0.00	0.78	0.00	0.44	0.00	0.00	0.00	0.00
Yellow Warbler	2.35	3.92	0.59	2.35	3.68	5.00	4.85	7.06
Yellow-breasted Chat	0.98	0.20	0.15	0.59	1.62	1.91	0.74	1.62
Yellow-headed Blackbird	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.15
Yellow-rumped Warbler	0.00	0.00	0.00	0.15	0.15	0.29	0.29	0.00

^a Densities are individuals per square kilometer observed >51m from the transect line during the month of June

Section 4

Conclusions

4. Conclusions

The Site provides a unique refuge along the central Front Range for a large number of bird and mammal species. The presence of this refuge results in large part from most of the Site having been protected for more than two decades from grazing, development, and other disturbances. The area enclosed by the 1950s BZ has experienced this singular habitat protection for more than 40 years. The exclusion of grazing and development has allowed the native prairie/montane ecotonal area in the BZ to rebound from its previously overgrazed state. The Site does, however, suffer from the influences of nearby development, adjacent industrial activities, and regional weed infestations. While wildlife movement corridors continue to remain open, providing more mobile species with the opportunity to enter and leave the Site at will, the Site is becoming more isolated from adjacent ecological communities each year. It was in recognition of the Site's role in the greater Rocky Flats ecosystem that DOE, RFFO and the USFWS entered into their interagency agreement to create the Rock Creek Reserve and thereby protect some of the more valuable and unique ecological resources at the Site, including a portion of the Preble's mouse habitat. Other rare species have been identified within the area of the presently designated Reserve. A species list of wildlife and plants that have been recorded in the Reserve is presented in Appendix D. Continued careful management is necessary to prevent outside and onsite influences from degrading the current high quality of the Site's natural resources.

Large-scale real estate development, mining, and water diversions on other large tracts of land along the Front Range have already destroyed or degraded much of the native habitat that was once available. It is due to the protection and isolation of the BZ that rare or imperiled species, and the present species diversity, are found at the Site. A number of the species at the Site are sensitive species or indicator organisms that by their presence—or more significantly, by their absence—indicate the ecological health of an area.

At the end of the 1999 field season, 256 terrestrial vertebrate species had been verified as using the Site's ecosystems—at least occasionally. With ecologists in the field year-round, new species are still observed each year, either during formal surveys or fortuitously. The new species in 1999 included the great egret, the black vulture, the orange-crowned warbler, the bushy-tailed woodrat, and the snapping turtle. This is an impressive diversity when compared to the 322 terrestrial vertebrate species found at Rocky Mountain National Park, which covers an area 98 percent larger than the Site. The Site's diversity includes 194 species of birds (19 are raptors), 3 big game species, 11 species of carnivores, 3 lagomorphs, 7 large rodents, 22 small mammal species, 10 reptiles, and 7 amphibians recorded since 1991. No definitive inventory of arthropods and other invertebrates has been made, but baseline sampling produced a large array of arthropod taxa. This high species diversity and continued use of the Site by numerous

special-concern species verifies that habitat quality for these species has remained acceptable and that ecosystem functions are being maintained.

One of the goals of the *Integrated Monitoring Plan – Ecology* segment (K-H 1998a) is to make annual assessments of endpoints for wildlife populations at the Site. Monitoring performed under the NRCPP tracks the populations of wildlife species and indicates the ecological health of the Site, as well as identifying effects from nearby activities.

A healthy natural environment provides a wide variety of ecological niches. This ecological health is reflected in species richness and population dynamics. All wildlife species in an ecosystem require healthy, well-balanced habitats in which to live and reproduce. Degraded habitat is reflected by lower numbers and reduced diversity of wildlife. The data collected during the 1999 field effort indicate that wildlife populations are stable and species richness remains high. Therefore, current Site activities are not having an adverse effect on the Rocky Flats ecosystem.

The mule deer population has fluctuated, and is currently estimated at about 140 to 150 animals. Male-to-female and young-to-adult ratios are well within the constraints of what wildlife experts consider a very healthy deer herd. White-tailed numbers have continued to increase, though the population of this species is still very small compared to that of the mule deer. Completing an accurate census of migratory waterfowl, carnivores, and herptiles is more difficult, but these species continued to be observed in numbers similar to past years. The coyote population maintained several packs across the Site, and several natal dens were discovered. The four raptor species that most commonly nest at the Site successfully reared young in 1999. The normal migratory assemblage of waterfowl visited the Site in the spring and fall of 1999, and the species that commonly breed at the Site were recorded with broods of young.

Preble's mice were captured in all three sections of Walnut Creek where trapping was conducted, with the A-series trapping yielding the most mice. Through mark-recapture analysis, the mouse population in the Walnut Creek drainage in 1999 was estimated at 41 (± 3) mice in suitable habitat. By combining the 1999 trapping data from Walnut Creek with the 1998 trapping data from Rock Creek, it became possible to compute a population estimate for Rock Creek as well. The estimated number of mice in suitable habitat in Rock Creek was 71 (± 14) mice. Movement calculations, based on telemetry tracking data, revealed that Preble's mice traveled approximately 56 m (184 ft), on average, over a 24-hour period, and 298 m (978 ft), on average, over the length of stream used for more than 20 days in Walnut Creek. Compared to travel in Rock Creek in 1998, mice in Walnut Creek traveled considerably shorter distances during monitoring. Based on the 1998 data, mice in Rock Creek traveled approximately 133 m (436 ft), on average, in 24 hours, and 689 m (2,061 ft), on average, over the length of stream used for more than 20 days. The restricted movement demonstrated in Walnut Creek was not unexpected, considering the non-contiguous nature of the habitat in that drainage.

With the addition of amphibian and fish monitoring, the ecology program has improved its ability to monitor and evaluate the limited aquatic community at the Site. Fish species

found in the ponds were consistent with those expected in the headwaters—except for the bass species that have undoubtedly been introduced to the Site. The USFWS, which co-manages the Rock Creek Reserve with DOE, RFFO, has announced its intention to eliminate the largemouth bass from the Lindsay Pond, so it can introduce a rare native species as an experimental recovery population.

The boreal chorus frog vocalization surveys conducted in 1999 continued to document a well-distributed and abundant population at the Site. This suggests that the general health of the aquatic ecosystems on Site is good. Future monitoring will continue to track and document the boreal chorus frog abundance and distribution at the Site.

Red-winged blackbirds were the most abundant migratory bird species across the Site in 1999. European starling observations in 1999 decreased to about half the abundance observed in 1998. Such abundance of this Eurasian invader is still a cause for concern, because this species affects many of the neotropical migrants that are commonly known to be declining in numbers across their entire range. House finches, though still abundant, dropped to fourth most abundant year-round. Because finches as a group are highly migratory throughout the year, fluctuations in the abundance of this group can be expected. Several other species are also quite abundant at the Site, largely on a seasonal basis. These species include the western meadowlark, vesper sparrow, song sparrow, and barn swallow.

Overall, the breeding season diversity indices for the Site for all habitats combined over the past eight sample years (1991, 1993–1999) show a steady trend. Most habitats within the Site show a similar steady trend, with the exception of woodland/shrubland habitats, which show an upward trend in species richness and a substantial downward trend in bird density.

The long-term, year-round ecological monitoring program conducted under the NRCPP continues to be an essential tool for identifying, describing, and quantifying fluctuations in wildlife populations, wildlife habitat use, and changes in the species that use the Site as year-round or seasonal habitat. Wildlife population densities vary constantly with natural pressures, and only well-integrated, long-term monitoring such as this can identify consequences of natural influences versus consequences of human activities. The data produced are an invaluable tool in predicting and avoiding ecological impacts resulting from projected human activities. If sensitive species dwindle in numbers or disappear, a serious environmental health problem is indicated. Monitoring and surveys such as those carried out by the NRCPP detect trends of this sort, and act as an “early warning system” for impending ecological problems. This function will become increasingly important as remediation activities at the Site increase, and will play an essential role in assessing natural resource damages.

Section 5

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Appendix A

**Code Entry Explanations and
Instructions for Data Entry of
Sitewide and Multi-Species
Surveys, and Fortuitous
Observations of Significant
Species, into Ecological
Database**

DATA ENTRY CODES FOR SIGNIFICANT SPECIES DATA

The following codes are used for data entry on data sheets for Multi-species Census Surveys, which are subsequently entered into the Relative Abundance Database (RAD), and data sheets for Sitewide Significant Species Surveys, which are subsequently entered into the Sitewide Survey Database (SSD). These codes are also used for fortuitous observations. These codes are standardized throughout the Sitewide Ecological Database, and must be used for uniformity.

Observer

Enter initials of the primary observer (up to 3 letters).

Date of Observation

Input observation date as mm/dd/yy (e.g., 02/04/98)

Time of Observation

Enter observation time using 24-hour military time clock (e.g., 1310 for 1:10 PM)

Type of Observation (Obs. type)

Observation Codes:

1	=	Visual (includes dead individuals)
2	=	Trap/Net Capture
3	=	Hand Capture
4	=	Radio Fix
5	=	Tracks
6	=	Scat/Pellets
7	=	Hair/Feathers/Other Remains
8	=	Sound/Vocalization
9	=	Photographic Evidence
10	=	Nest/Eggs

Taxonomic Group Code (Taxn Grup)

Groups to be recorded include big game mammals; furbearers; small game mammals; upland game birds; waterfowl, shorebirds and wading birds; raptors; reptiles and amphibians; and threatened, endangered, and candidate species.

Taxonomic Group Codes:

B	=	Big Game	R	=	Raptors
C	=	Carnivores	U	=	Upland Game Birds
Y	=	Lagomorphs (Rabbits and Hares), Large Rodents (Muskrats, Prairie Dogs), Bats	W	=	Waterbirds (Waterfowl, Shorebirds, Wading Birds)
H	=	Herptiles (Reptiles/Amphibians)	L	=	Lepidoptera
F	=	Fish			
S	=	Songbirds			

Species Code

Enter species code from Current Approved Species Code (see Attachment A).

Observation Area (Admin Area)

Enter code for observation area relative to Rocky Flats:

Administrative Area Codes:

PA	=	Protected Area
IA	=	Industrial Area
BZ	=	Buffer Zone
EA	=	Extended Observation Area*

*Within 10 km of Rocky Flats boundary.

Name of Observation Location (Site Name)

Enter name of transect.

Name of Operable Unit (OU)

Enter Operable Unit name of observation area, if applicable.

North-South Rocky Flats Grid Code (RF Grid N)

Enter alphanumeric code number (1-17) for location of observation according to Rocky Flats Grid.

East-West Rocky Flats Grid Code (RF Grid E)

Enter alphanumeric code letter (A-U) for location of observation according to Rocky Flats Grid.

Activity Codes (Activity 1 & Activity 2)

Enter primary activity code in Activity column and secondary activity code in Activity 2 column.

Activity Codes:

Fauna:			
0	=	Inactive/Immobile	13 = Socialization/Playing
1	=	In Transit	14 = Being Prey
2	=	Walking/Leisurely Flight	15 = Drinking
3	=	Running/Rapid Flight	16 = Swimming
4	=	Fleeing	17 = Territorial Behavior
5	=	Feeding/Hunting	18 = Dead
6	=	Courtship	19 = Defense of Young
7	=	Nursing/Feeding Young	20 = Giving Birth
8	=	Nesting/Incubating	21 = Sick/Injured
9	=	Nesting/Brooding	22 = Asleep
10	=	Nest Building	23 = In Trap
11	=	Fighting/Aggression	24-49 = (Open)
12	=	Grooming/Preening	

Description of Habitat at Observation Location (Habitat Type 1, Habitat Type 2)

Enter primary habitat code for Habitat Type 1. Enter secondary habitat code for Habitat Type 2. See list below for wildlife habitat codes.

Wildlife Habitat Codes:

Code	Habitat Description	Code	Habitat Description
000	Aquatic and Wetlands Habitats Group	093	Impoundment Edge

<i>Terrestrial Subgroup</i>		094	Dugout Edge
010	Wet Meadow/Marsh Ecotone	095	Ditch Edge
020	Short Marsh (Carex/Juncus)	100	Woodlands Habitats Group
030	Tall Marsh (Typha/Scirpus)	110	Riparian Woodland (Populus, Salix and Associated)
<i>Open Water Subgroup</i>		120	Ponderosa Woodland (Pinus ponderosa and Associated)
040	Streams and Rivers	125	Douglas-fir Woodland (Pseudotsuga menziesii and Associated)*
041	Intermittent Stream - Riffle	130	Tree Plantings (Ornamentals and Shelterbelts)
042	Intermittent Stream - Run	200	Shrublands Habitats Group
043	Intermittent Stream - Pool	210	Riparian Shrubland (Salix, Amorpha, and Associated)
044	Persistent Stream - Riffle	211	Riparian Shrubland - Amorpha
045	Persistent Stream - Run	212	Riparian Shrubland - Salix
046	Persistent Stream - Pool	220	Short Upland Shrubland (Symphoricarpos and Associated)
047	Ditch (Drainage/Irrigation) - Riffle	230	Tall Upland Shrubland (Crataegus, Prunus, and Associated)
048	Ditch (Drainage/Irrigation) - Run	240	Rabbitbrush Shrubland (Chrysothamnus and Associated)
049	Ditch (Drainage/Irrigation) - Pool	250	Mountain Mahogany/Bitterbrush Shrubland (Cercocarpus, Purshia, and Associated)
050	Ponds and Impoundments	260	Savannah Shrubland (Rhus, Ribes, Physocarpus, and Associated)
051	Natural Pond - Littoral Zone*	300	Grasslands Habitats Group
052	Natural Pond - Limnetic Zone*	310	Short Grassland (Buchloe, Bouteloua, and Associated)
053	Natural Pond - Profundal Zone*	320	Mixed Grassland (General)
054	Impoundment - Littoral Zone	322	Mesic Mixed Grassland (Agropyron, Bouteloua, Poa, and Associated)
055	Impoundment - Limnetic Zone	323	Xeric Mixed Grassland (Andropogon, Stipa, Muhlenbergia, and Associated)
056	Impoundment - Profundal Zone	324	Reclaimed Mixed Grassland (Planted grass mixtures)
057	Dugout/Excavated Pond - Littoral Zone	325	Overgrazed Pasture
058	Dugout/Excavated Pond - Limnetic Zone	400	Disturbance Habitat Group
059	Dugout/Excavated Pond - Profundal Zone	410	Annual Grass/Forb (Bromus japonicus, Bromus tectorum, Centaurea, Helianthus)
060	Lakes and Reservoirs*	420	Disturbed/Barren Lands (Roads, dirt lots)
061	Littoral Zone	430	Cultivated Lands*
062	Limnetic Zone	500	Structures and Structure Associations Habitats Group
063	Profundal Zone	510	Transmission Lines
070	Springs and Seeps	520	Buildings/Structures
071	Persistent	530	Rock and Gravel Piles
072	Intermittent	540	Roadside/Fencerow Complex
080	Groundwater	550	Debris Piles
<i>Emergent Subgroup</i>		560	Fence
090	Mudflats	600	Special Features Group*
091	Stream Edge	610	Cliffs
092	Natural Pond Edge*	620	Caves

Temperature During Observation (Temp)

Enter temperature in degrees Celsius, enter temperatures below zero with a minus (e.g., -4°C).

Wind Speed (Wind Speed)

Enter approximate wind speed in miles per hour. (If a range is entered on the datasheet, use the rounded average of values [e.g., if 5-10 mph was recorded, the data entry in the database would be entered as 8 mph].)

Wind Direction (Wind Direct)

Enter wind direction using directional code up to 2 letters.

Wind Direction Codes:

N	=	North
NE	=	Northeast
E	=	East
SE	=	Southeast
S	=	South
SW	=	Southwest
W	=	West
NW	=	Northwest

Significant Weather Conditions Present (Weather)**Weather Condition Codes:**

0	=	No significant weather conditions
1	=	Fog/smog, visibility less than 1 km
2	=	Drizzle or mist
3	=	Rain
4	=	Hail
5	=	Snow or sleet
6	=	Thunderstorm
7	=	Blowing sand or dust

Number of Males (Male)

Enter number of males.

Number of Females (Female)

Enter number of females.

Number of Young (Young)

Enter number of young.

Number of Unclassified Individuals (Un-Classd)

Enter number of unclassified individuals.

ATTACHMENT A: SPECIES CODES FOR DATA ENTRY

AMPHIBIANS

AMBYSTOMATIDAE

<i>Ambystoma tigrinum</i>	Tiger Salamander	AMTI1
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PELOBATIDAE

<i>Scaphiophus bombifrons</i>	Plains Spadefoot	SCBO1
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BUFONIDAE

<i>Bufo cognatus</i>	Great Plains Toad	BUCO1
<i>Bufo woodhousei</i>	Woodhouse's Toad	BUWO1

HYLIDAE

<i>Pseudacris triseriatus maculata</i>	Boreal Chorus Frog	PSTR1
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RANIDAE

<i>Rana catesbeiana</i>	Bullfrog	RACA1
<i>Rana pipiens</i>	Northern Leopard Frog	RAPI1

REPTILES

CHELYDRIDAE

<i>Chelydra serpentina</i>	Snapping Turtle	CHSE1
<i>Chrysemys picta</i>	Western Painted Turtle	CHPI1

IGUANIDAE

<i>Phrynosoma douglassi</i>	Short-horned Lizard	PHDO1
<i>Sceloporus undulatus</i>	Eastern Fence Lizard	SCUN1

COLUBRIDAE

<i>Coluber constrictor</i>	Eastern Yellowbelly Racer	COCO1
<i>Pituophis melanoleucus</i>	Bullsnake	PIME1
<i>Thamnophis radix</i>	Western Plains Garter Snake	THRA1
<i>Thamnophis sirtalis</i>	Red-sided Garter Snake	THSI1

VIPERIDAE

<i>Crotalus viridis</i>	Prairie Rattlesnake	CRVI1
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BIRDS

PODICIPEDIDAE

<i>Aechmophorus occidentalis</i>	Western Grebe	AEOC1
<i>Podiceps nigricollis</i>	Eared Grebe	PONI1
<i>Podilymbus podiceps</i>	Pied-billed Grebe	POPO1

PELECANIDAE

<i>Pelecanus erythrorhynchos</i>	American White Pelican	PEER1
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PHALACROCORACIDAE

<i>Phalacrocorax auritus</i>	Double-crested Cormorant	PHAU1
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ARDEIDAE

<i>Casmerodius albus</i>	Great Egret	CAAL1
<i>Ardea herodias</i>	Great Blue Heron	ARHE1
<i>Butorides striatus</i>	Green-backed Heron	BUST1
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron	NYNY1

ANATIDAE

<i>Aix sponsa</i>	Wood Duck	AISP1
<i>Anas acuta</i>	Northern Pintail	ANAC1
<i>Anas americana</i>	American Wigeon	ANAM1
<i>Anas clypeata</i>	Northern Shoveler	ANCL1
<i>Anas crecca</i>	Green-winged Teal	ANCR1
<i>Anas cyanoptera</i>	Cinnamon Teal	ANCY1
<i>Anas discors</i>	Blue-winged Teal	ANDI1
<i>Anas platyrhynchos</i>	Mallard	ANPL1
<i>Anas strepera</i>	Gadwall	ANST1
<i>Aythya affinis</i>	Lesser Scaup	AYAF1
<i>Aythya americana</i>	Redhead	AYAM1
<i>Aythya collaris</i>	Ring-necked Duck	AYCO1
<i>Aythya marila</i>	Greater Scaup	AYMA1
<i>Aythya valisineria</i>	Canvasback	AYVA1
<i>Branta canadensis</i>	Canada Goose	BRCA1
<i>Bucephala albeola</i>	Bufflehead	BUAL1
<i>Bucephala clangula</i>	Common Goldeneye	BUCL1
<i>Chen caerulescens</i>	Snow Goose	CHCA1
<i>Lophodytes cucullatus</i>	Hooded Merganser	LOCU1
<i>Mergus merganser</i>	Common Merganser	MEME1

CATHARTIDAE

<i>Coragyps atratus</i>	Black Vulture	COAT1
<i>Cathartes aura</i>	Turkey Vulture	CAAU1

ACCIPITRIDAE

<i>Accipiter cooperii</i>	Cooper's Hawk	ACCO1
<i>Accipiter gentili</i>	Northern Goshawk	
<i>Accipiter striatus</i>	Sharp-shinned Hawk	ACST1
<i>Aquila chrysaetos</i>	Golden Eagle	AQCH1
<i>Buteo jamaicensis</i>	Red-tailed Hawk	BUJA1
<i>Buteo lagopus</i>	Rough-legged Hawk	BULA1
<i>Buteo regalis</i>	Ferruginous Hawk	BURE1
<i>Buteo swainsoni</i>	Swainson's Hawk	BUSW1
<i>Circus cyaneus</i>	Northern Harrier	CICY1
<i>Haliaeetus leucocephalus</i>	Bald Eagle	HALE1
<i>Pandion haliaetus</i>	Osprey	PAHA1

FALCONIDAE

<i>Falco columbarius</i>	Merlin	FACO1
<i>Falco mexicanus</i>	Prairie Falcon	FAME1
<i>Falco peregrinus</i>	American Peregrine Falcon	FAPE1
<i>Falco sparverius</i>	American Kestrel	FASP1

PHASIANIDAE

<i>Meleagris gallopavo</i>	Wild Turkey	MEGA1
<i>Phasianus colchicus</i>	Ring-necked Pheasant	PHCO1

RALLIDAE

<i>Fulica americana</i>	American Coot	FUAM1
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GRUIDAE

<i>Grus canadensis</i>	Sandhill Crane	GRCA1
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SCOLOPACIDAE

<i>Limnodromus scolopaceus</i>	Long-billed Dowitcher	LISC1
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STRIGIDAE

<i>Asio flammeus</i>	Short-eared Owl	ASFL1
<i>Asio otus</i>	Long-eared Owl	ASOT1
<i>Athene cunicularia</i>	Burrowing Owl	ATCU1
<i>Bubo virginianus</i>	Great Horned Owl	BUVI1

APODIDAE

Cypseloides niger

Black Swift

CYNI1

TYRANNIDAE

Empidonax occidentalis
Empidonax traillii

Cordilleran Flycatcher
Willow Flycatcher

EMDI1
EMTR1

LANIIDAE

Lanius ludovicianus

Loggerhead Shrike

LALU1

Emberizinae

Ammodramus bairdii

Baird's Sparrow

AMBA1

MAMMALS

ORDER CHIROPTERA

VESPERTILIONIDAE

Myotis subulatus
(=*M. ciliolabrum*)

Small-footed Myotis

MYSU1

ORDER LAGOMORPHA

LEPORIDAE

Lepus californicus
Lepus townsendii
Sylvilagus audubonii

Black-tailed Jackrabbit
White-tailed Jackrabbit
Desert Cottontail

LETO1

LECA1

SYAU1

ORDER RODENTIA

SCIURIDAE

Cynomys ludovicianus
Sciurus niger

Black-tailed Prairie Dog
Eastern Fox Squirrel

CYLU1
SCNI1

CASTORIDAE

Castor canadensis

Beaver

CACA1

MURIDAE

<i>Ondatra zibethicus</i>	Muskrat	ONZI1
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ZAPODIDAE

<i>Zapus hudsonius preblei</i>	Preble's Meadow Jumping Mouse	ZAHU1
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ERETHIZONTIDAE

<i>Erethizon dorsatum</i>	Common Porcupine	ERDO1
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ORDER CARNIVORA

URSIDAE

<i>Ursus americanus</i>	American Black Bear	URAM1
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PROCYONIDAE

<i>Procyon lotor</i>	Raccoon	PRLO1
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MUSTELIDAE

<i>Mephitis mephitis</i>	Striped Skunk	MEME1
<i>Mustela frenata</i>	Long-tailed Weasel	MUFR1
<i>Mustela vison</i>	Mink	MUVI1
<i>Taxidea taxus</i>	American Badger	TATA1

CANIDAE

<i>Canis latrans</i>	Coyote	CALA1
<i>Urocyon cinereoargenteus</i>	Common Gray Fox	URCI1
<i>Vulpes vulpes</i>	Red Fox	VUVU1

FELIDAE

<i>Felis concolor</i>	Mountain Lion	FECO1
<i>Lynx rufus</i>	Bobcat	LYRU1

ORDER ARTIODACTYLA

CERVIDAE

<i>Cervus elaphus</i>	Elk (Wapiti)	CEEL1
<i>Odocoileus hemionus</i>	Mule Deer	ODHE1
<i>Odocoileus virginianus</i>	White-tailed Deer	ODVI1
<i>Odocoileus hemionus x virginianus</i>	Mule X White-tailed Deer	HEXVI

Appendix B

1999 Preble's Meadow Jumping Mouse Study

Appendix B

1999 Study of the Preble's Meadow Jumping Mouse at the Rocky Flats Environmental Technology Site

Kaiser-Hill Company, LLC
Rocky Flats Environmental Technology
Site

Appendix B

1999 Study of the Preble's Meadow Jumping Mouse at the Rocky Flats Environmental Technology Site

Kaiser-Hill Company, LLC
Rocky Flats Environmental Technology Site
Golden, Colorado

May 2000

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1. Introduction

Small-mammal field efforts in 1999 at the Rocky Flats Environmental Technology Site (Site) concentrated on studying populations of the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Walnut Creek. Live trapping was performed both in known occurrence areas and in new locations within the drainage. The effort consisted of two major components: 1) a mark-recapture study to estimate the population, and 2) a radio telemetry tracking effort to monitor movements of individual mice within the drainage. These information needs were identified in 1998 by Site ecologists, and confirmed by the statewide scientific team that is evaluating the Preble's mouse. Walnut Creek was selected for the 1999 effort in keeping with the staggered schedule called for by the Site's Integrated Monitoring Plan (IMP; K-H 1999).

During 1998, Site ecologists conducted a similar monitoring effort in Rock Creek (K-H 1999a). In that study, Preble's mice were captured in new segments of Rock Creek, and telemetry data demonstrated that some individuals move considerable distances. Nine individuals traveled an average of 142 m (464 ft) over a 24-hour interval and used 715 m (2,346 ft), on average, of stream segment during one month in the summer (K-H 1999a). Results of previous trapping in Woman Creek indicated that Preble's mice travel distances of 1,205 to 1,610 m (0.75 to 1 mile) within the stream drainage (K-H 1997). Observations from these two studies suggested extensive use of stream reaches where habitat is contiguous. Woman and Rock Creek have relatively long stretches of continuous habitat, especially in the upper third and two-thirds of each stream within Site boundaries, respectively. However, Walnut Creek has a much less continuous distribution of habitat, due to the water impoundments and a highly regulated water regime. Walnut Creek is the main carrier of effluent from the Industrial Area's domestic water treatment system and is therefore subject to intensive regulation and water flow management. This manipulation of the stream has resulted in a discontinuous, or patchy, distribution of habitat within the drainage, with separation of the habitat units by intervening ponds and dams. Site ecologists were generally interested in discovering whether the patchy habitat influences the travel distances and population distributions compared to Rock Creek.

The main objectives of the 1999 field effort were to 1) determine nightly and monthly movement patterns of Preble's mice within Walnut Creek, 2) monitor selected known population centers in Walnut Creek, and 3) study the demographics of the Walnut Creek population. These objectives were addressed by trapping in areas of known Preble's mouse occurrence and in areas in the Walnut Creek drainage where they had not been documented previously, and by monitoring individual mice via radio tracking. Population estimates were made using mark-recapture methodology.

2. Study Questions

The 1999 field effort was designed to address questions about movement and dispersal, occurrence and population estimates, and habitat characteristics in Walnut Creek.

2.1 Trapping and Population Estimates

General question: *How many Preble's mice are in the Walnut Creek drainage?*

Specific questions:

- What are the population estimates for each transect trapped or series (pooled set of transects), assuming that a seven-trap-night session approximates a "closed" population?
- What are the age and sex ratios within Walnut Creek?
- What are the over-summer survival estimates?
- Are the Walnut Creek 1999 population estimates comparable to those of 1995?

2.2 Movement and Dispersal

General question: *What distances do Preble's mice move during early and late summer within the Walnut Creek drainage (based on radio telemetry)?*

Specific questions:

- How far does an individual mouse move between two observations within a 24-hour period (average and maximum distances)?
- How far does an individual mouse move during one month (average and maximum distances)?
- What is the maximum distance, perpendicular to the stream, at which mice are detected?
- What are the apparent travel routes (e.g., through the riparian corridor or otherwise)?
- What is the estimated (average) home range of Preble's mice?

2.3 Vegetation Type/Habitat Characteristics

General question: *If Preble's mice are found in new locations in the Walnut Creek drainage, are they found in the same type of habitat that they occupy elsewhere on the Site?*

Specific questions:

- When Preble's mice are captured in new areas, are the habitat characteristics the same as in previously described locations?
- In the event that breeding or nesting areas are located, what is the general habitat description of these areas?
- Are habitat characteristics of breeding or nesting areas different from the current known habitat?
- Are habitat characteristics of hibernation sites different from the current known habitat?

3. Methods

3.1 Trapping

Trapping for Preble's meadow jumping mice and other small mammals followed the procedures for small mammals outlined in the *EMD Operating Procedures Manual Volume V* (DOE 1994) and conformed to the U.S. Fish and Wildlife Service *Interim Survey Guidelines for Preble's Meadow Jumping Mouse* (USFWS 1998). Animals were trapped in Longworth and Sherman small-mammal live traps using Purina® Sweet Feed as bait.

To facilitate estimation of the Preble's mouse population in Walnut Creek, the sampling frame encompassed all known and suitable habitat within the drainage. This sampling frame consisted of 18 1-ha sampling sites, from which 11 sites were selected at random for trapping (Figure 1). The eleven sites were trapped over two sessions (20 May to 18 June, and 23 August to 16 September). During each session, four sampling sites were trapped the first week, four more sites were trapped during the second week, and the remaining three sites were trapped during the third week. The groupings of the sites trapped happened to correspond to the tributaries in Walnut Creek (Figure 1). The A-series tributary was trapped first, then the lower reach of the stream, then the B-series tributary. Because of the low number of Preble's mice captured, an extra sampling site was added to the A-series group during the first session (for a total of 12 transects), and another was added to the B-series group in the second session, for a total of 13 sampling sites. These sites were added in an effort to capture and collar a larger number of individuals.

Within each selected site, a transect of 50 traps was established as two rows of 25 traps each, running parallel to the stream on either side. The traps were spaced 5 m apart, with the two parallel rows about 10 m apart. A transect is considered a representative sample of a site.

Each transect was run for seven consecutive days or until 350 trap-nights per site were achieved. The mark-recapture technique relies on a "closed" (White et al. 1982) seven-trap-night period, which can be compared from season to season or year to year. The seven-day trapping period assumes no migration or deaths while still allowing for multiple mark-recapture estimates. Population estimates were calculated based on the Lincoln-Peterson Index (Golley et al. 1975).

Each small mammal captured was identified by species, age, and sex. Any evidence of breeding activity, such as lactating or pregnant females and scrotal males, was noted. Each Preble's mouse captured was measured for key identifying characteristics, including head and body length, ear length, tail length, hind-foot length, and body weight.

Weather conditions were recorded at the time the traps were checked. All data were recorded on approved field data sheets, entered into the Ecology database, verified, and validated.

3.2 Marking

Population estimates relied on mark-recapture methodology. All Preble's mice captured in Walnut Creek were marked with Passive Integrated Transponder (PIT) tags. Protocols developed by the Preble's Mouse Science Team in the spring of 1998 were followed for inserting the PIT tags into the mice. Every individual Preble's mouse captured was marked, whether it was collared or not. During subsequent recapture efforts, all Preble's mice were scanned with the PIT tag reader to determine whether they had been marked.

3.3 Radio Telemetry

The field work for radio telemetry included conducting field trials of equipment, establishing telemetry monitoring stations, trapping mice and affixing collars, and finally, radio-tracking individuals in the field. The telemetry procedures were developed initially at the U.S. Air Force Academy by the Colorado Natural Heritage Program, and were adopted by the Preble's Mouse Science Team. Site ecologists slightly refined the procedures during Rock Creek monitoring in 1998 (K-H 1999a). These steps are described in detail below.

Two Telonics, Inc., Model TR-2 receivers were used to monitor the collared mice, with a TR-1 receiver available to serve as back up. The transmitters operated at individual frequencies between 172 and 174 MHz.

3.3.1 Equipment Field Testing

The receivers were tested for performance and maximum detectable range prior to trapping. Each transmitter was tested for performance just prior to collaring. Specific methods for performing these trials were provided by Telonics, Inc.

3.3.2 Establishment of Telemetry Stations

Ten preliminary "monitoring stations" were established at locations on each side of the stream that offered a clear line of sight to a large area. New stations were established when mice moved into new areas or when a new station was more efficient for taking readings. Coordinates for all stations were obtained using a global positioning system (GPS) unit, and were recorded in Universal Transverse Mercator (UTM) coordinates. The stations were located within an accuracy of ± 0.5 m to provide the most accurate data possible for estimating spot locations and travel distances.

3.3.3 Radio Telemetry Readings

Telemetry work began as soon as the first mouse was collared. Only adults were collared, and an attempt was made to collar the same number of males and females. The first-session collaring effort in Walnut Creek began 22 May and continued until 16 July, during which time, 12 individuals were collared. The second-session collaring effort began 25 August and continued until 7 October, during which time, eight individuals were collared.

First-session telemetry was conducted mainly at night. Animals were located a minimum of twice per night. This frequency was considered to sufficiently represent nighttime movement, based on 1998 telemetry data from Rock Creek (K-H 1999a). Second-session telemetry was conducted mainly during the day, because previous telemetry results have shown that individuals travel far less as their hibernation time approaches. Field personnel avoided approaching too closely or pursuing the collared animal, because observation of normal movements was essential. Each person taking readings recorded all locations in a field notebook by noting the date, time, station number, collar frequency, whether trapping was being conducted at the time, and the compass direction in degrees from which the signal was emanating.

For each point location recorded, compass bearings to each transmitter were collected from at least three to four monitoring stations to ensure a minimum of three valid bearings. Every effort was made to ensure that bearings were more than 60° and less than 120° from one another. In this manner, the most accurate location data were gathered. Bearings from the established monitoring stations were recreated in ArcView® using a program developed by Ternary Spatial Research, of Denver. This program was subsequently enhanced by Exponent to correct some code and expand the type of data that the program can accept. The intersection of valid bearing lines approximated the transmitter's location. The UTM coordinates of the estimated points were derived in ArcView® and transferred into a telemetry database.

When telemetry analysis was finished, all locations were quality checked and summarized. Then the maximum and average distances traveled by each individual were calculated.

3.4 Habitat Characterization

Preble's mouse habitat is defined as the combination of vegetation types and abiotic conditions that support Preble's mice. Areas in which Preble's mice were trapped are considered to be suitable habitat. Habitat was characterized at the trap-station (microsite) level. Microsites characterize habitat at a fine level of detail and refer only to active-season (summer) habitat. A transect is characterized by summarizing the measurement values from all the sampled trap stations. For the Walnut Creek sites, microsite habitat was characterized only where Preble's mice had not been captured previously or where breeding or nesting was documented.

Beginning on 6 July, 10 trap stations from each transect in areas where Preble's mice were captured this year, but not in previous years, were characterized. These 10 stations were then averaged to characterize the entire transect. The 10 stations were pre-selected to be stations 2, 7, 12, 17, 21, 28, 32, 36, 42, and 46. Trap stations other than these where Preble's mice were actually caught were substituted for the nearest predetermined station, as long as the entire length of the transect could be represented.

3.5 Habitat Parameters

Three different types of habitat information were gathered in a circular plot within a 3-m radius (28.3 m^2) of each selected trap station: physical habitat, plant species composition, and vegetation structure.

Physical habitat measurements are non-vegetative, abiotic features of the habitat. Eight physical measurements were taken: 1) the trap position in relation to the canopy, 2) slope aspect, 3) slope angle, 4) slope position, 5) moisture gradient, 6) soil texture at the trap station, 7) distance to the stream, and 8) distance to the nearest continuous woody riparian canopy when the trap position was outside of the canopy. Table A-1 in Attachment A lists the habitat endpoints and the methods used to measure them.

Characterizing plant species composition entailed identifying the generalized habitat types, determining the plant species richness within the circle plot (center located at the trap station), and noting all woody species that make up the canopy (if any) at the trap station.

Three vegetation structural measurements were made at each trap station: 1) tree/shrub canopy cover at the center point of the plot; 2) vertical vegetation density at the center point of the plot; and 3) a visual estimate of foliar cover for trees, shrubs, short shrubs (snowberry and rose), grasses, and forbs over the entire plot.

Tree/shrub canopy cover was measured using a spherical crown densiometer placed 1 m above the ground at the center of the circle plot. A vegetation profile board (1 m^2 graduated by decimeters; after Nudds 1977), read at a distance of 5 m and a height of approximately 1 m, was used to measure vertical vegetation density. Foliar cover estimates were determined using percent cover classes (see Attachment A).

A woody index and an herbaceous index were derived from the cover class estimates of trees, shrubs, short shrubs, grass, and forbs. The woody index is defined as the summed cover values for trees, shrubs, and short shrubs, with a possible cover value of 300 percent in some cases. The herbaceous index is defined as the summed cover values for grass and forbs. This measure provided an additional means of examining vegetation structure.

4. Data Analysis

4.1 Population Estimates

The Walnut Creek Preble's mouse 1999 trapping data were used to calculate population estimates by mark-recapture methods. A trapping matrix was created and input to Program Mark™, a software program for use in estimating wildlife populations (Cooch and White 1998). Due to the low number of Preble's mice captured at individual transects, analysts used data pooling. This was done by combining results from all transects in each of the trapping series (i.e., A, B, and Lower Walnut series). Within each series, transects are relatively close together and can be considered contiguous in most areas.

With the additional capture data provided from trapping this year, an estimate for 1998 Rock Creek was possible by pooling the data (i.e., combining Walnut and Rock Creek trapping data). This pooled data set was used to calculate population estimates for Rock Creek in 1998 and re-calculate the estimates for Walnut Creek in 1999. This pooled approach had no significant effect on the Walnut Creek estimate except to slightly change the capture probability from what would have been originally reported (i.e., a capture probability based only on Walnut Creek trapping data would be different from that based on the pooled trapping data).

4.2 Movement Estimates

Walnut Creek radio telemetry data were used to calculate the daily (i.e., over a 24-hour observation period) and monthly minimum, maximum, and average movements of individuals, as well as maximum distance from the stream that each collared individual was observed. Because data were in the form of triangulated, calculated points, and not in real-time tracked movement, pathways were estimated.

Using the telemetry data, a data screening process was conducted in which error polygons were created based on points originating from three or more bearings. Any error polygons larger than 0.5 ha (1.2 acres) were flagged and re-evaluated. Where possible, bearings that appeared to be "bounce-back" signals were removed from a bearing set, creating a new point with only two to three bearings. This usually reduced the error polygon to below 0.5 ha. We avoided reducing the bearings to a set of two whenever possible, because to do so reduces the error polygon entirely. If a bounce-back bearing was not apparent, the entire bearing set was excluded from the analysis.

The screened telemetry data were subjected to an uncertainty analysis to determine the accuracy of calculated polygons (triangulations from bearings) relative to known visual observation points (GPS-located). To accomplish this analysis, 10 groups of bearings were compared against 10 equivalent visual observation points. The telemetry readings

for these bearing groups were made immediately before each corresponding visual observation. Coordinates for visual observation points were obtained using a GPS. Coordinates for all bearing groups and visual points were mapped in ArcView[®] prior to conducting the uncertainty comparison. The polygons plotted from the bearing groups were then compared to the GPS-located visual observation points. The uncertainty for each of these bearing groups was calculated as the distance from the visual point to the furthest distant point on the polygon.

Telemetry data were also used to calculate home ranges for each collared mouse. The kernel home range estimator (95% volume contour; Silverman 1986; Seaman and Powell 1996) was used to calculate Preble's mouse home ranges. The software package Home Ranger[™] was used to facilitate the calculations.

Due to the more refined analysis conducted with the Walnut Creek telemetry data, the 1998 Rock Creek telemetry data were re-run using the same analysis technique to develop comparable sets of telemetry data from each stream. Therefore, the recalculated results for Rock Creek are presented with the Walnut Creek results in this report. This includes movement endpoints and home ranges.

4.3 Habitat Measurements

The habitat endpoints for Preble's mouse habitat characterization (Attachment A) were used to describe areas where new captures were made. New sites in Walnut Creek were compared to the current Site habitat model parameters based on information from Rock and Woman Creeks. Additionally, comparisons of the habitat endpoints were made between years, where appropriate.

5. Results

5.1 Small Mammal Trapping Results

This section presents general results for all small mammal species, as well as results specific to the Preble's mouse population in Walnut Creek. Twelve transects were run in Walnut Creek during the first session, and thirteen transects were run during the second session.

5.2 All Small Mammal Species

During 8,750 trap nights (Table 1) in Walnut Creek, 4,219 small mammals were captured. During the first session, deer mice represented the largest percentage (50.1 percent) of small mammals captured, and meadow voles (59.9 percent) dominated second-sessions captures. Over both sessions, a total of eight small mammal species were captured.

The typical rise in the number of deer mice and harvest mice with the addition of young of the year was not observed in 1999 (Table 1). The number of deer mice observed during the second session was actually lower than during the first. Harvest mice represented a very low portion of total mammals captured. This is a continuing trend for harvest mice, as seen in Rock Creek in 1998. In 1995, trapping in both Rock and Walnut Creeks yielded 135 captures of harvest mice (K-H 1996). Woman Creek was trapped in 1997, and 75 captures of harvest mice were reported. Other researchers (Armstrong et al. 1996; Meaney et al. 1996, 1997) also reported low numbers of harvest mice while conducting Preble's mouse studies. There is insufficient information to draw any conclusions about the low numbers of harvest mice, but this apparent trend may bear watching if it continues. It may be just a result of how harvest mice select seasonal habitat, or some other variable that reduces the number captured during Preble's mouse trapping activities.

5.3 Preble's Mice

Twenty-nine captures (including recaptures) were made over both trapping sessions (Table 1). The relative abundance of Preble's mice was 0.33 per 100 trap nights. Twelve individuals (seven adult males, four adult females, and one juvenile male; Table 2) were captured during the first session. Eight individuals (five adult males, three adult females) were captured during the second session. Only one female mouse was captured during both sessions. These results constitute a sex ratio of 1.7 adult males for every adult female over both sessions. The age ratio is 18 adults to 1 juvenile reported. None of the 19 individuals captured in Walnut Creek was marked from previous years. Preble's mice were captured more frequently in the first session than in the second (19

captures vs. 10 captures; Table 1). Of the 19 individuals captured during both sessions, seven of them were recaptured, usually only once but up to four times.

Captures of Preble's mice in 1999 were comparable to those in 1995 (K-H 1996), with the exception that the 1995 trapping duration was much longer than the 1999 sessions. For comparison, 1995 Walnut Creek trapping yielded 62 captures of 21 individuals; a relative abundance of Preble's mice of 0.68 per 100 trap nights. Most of these captures occurred from August to October 1995. In 1995, 11 of the 21 individuals were captured more than once, with two individuals being recaptured nine times each (K-H 1996).

5.3.1 Population Estimates

Trapping results from the 12 Walnut Creek transects (Figure 1) and the 10 Rock Creek transects (Figure 2), each run over two sessions, were used to model three population parameters: capture probability, survival rates, and population estimates for Preble's mice. The data sets (i.e., 1998 – Rock Creek and 1999 – Walnut Creek) were pooled because earlier attempts to estimate Rock Creek populations were not possible due to the lack of recaptures. However, with the addition of the Walnut Creek data, a pooled approach that would yield results for both years was possible. Bruce Lubow, of Colorado State University, conducted the analysis with the input of Site ecologists. Initially, estimates based on individual transects were attempted, but because of the low capture and recapture rate, it was necessary to pool trapping data from multiple transects (i.e., by series) to get more robust estimates. Correspondingly, transect data were pooled to form the following sections:

- Walnut Creek
 - A-series upper (three transects)
 - A-series lower (two transects)
 - Lower Walnut (four transects)
 - B-series (three transects).
- Rock Creek
 - Upper Series (six transects)
 - Lower Series (four transects).

5.3.1.1 Capture Probability

A capture probability must be estimated first, before modeling all other population parameters. Program MarkTM, a mark-recapture software package, allows the analyst to try multiple population/survival models and helps select the model that is best fitted to

the data, using the Akaike's Information Criteria (AIC) (Burnham and Anderson 1998), or to pool model results to get a weighted average estimate. Numerous models were run to determine the best AIC fit from the trapping data set using the Robust Design model framework in Program Mark™. A model with different initial capture and recapture rates received the greatest support, although several models provided the most robust estimate overall. All results were based on a weighted average of the estimates from each of these models. Capture and recapture probability estimates (Est.) and standard errors (SE) are:

	Walnut Creek				Rock Creek			
	Session 1		Session 2		Session 1		Session 2	
	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Initial capture probability, p	0.304	0.059	0.304	0.059	0.296	0.069	0.296	0.069
Recapture probability, c	0.105	0.034	0.105	0.034	0.098	0.029	0.098	0.029

5.3.1.2 Immigration/Emigration Rate

Modeling immigration and emigration rates using the pooled Rock and Walnut Creek trapping results was attempted. The data were inadequate for computing a reliable rate of temporary emigration and immigration, so this value was assumed to be zero (i.e., no temporary migration occurred).

5.3.1.3 Survival Rate (Residency)

Determining survival rates is essential to estimating populations at various points in time (i.e., over two trapping sessions or over a winter season). After much consideration, a better explanation is provided by stating that this parameter is really a measure of site residency, because it represents the proportion of animals that survived *and* remained on the study site so as to be available for trapping. Therefore, this term should be referred to as apparent residency. As mentioned above, the data were insufficient to estimate residency rates for each transect separately. However, residency rates were computed for the Walnut and Rock Creek areas. The overall (pooled) residency rate is 9.2 percent for the period between sessions. This corresponds to a 45.2% average residency per month for the four sites at Walnut Creek and the two sites at Rock Creek combined.

5.3.1.4 Population Estimates

Along with residency-rate modeling, population estimates were correspondingly determined by attempting numerous models in Program Mark™ until robust estimates resulted. In the following table, N is the estimated number of individuals per trapping site, and se(N) is the standard error of that estimated number.

Walnut and Rock Creek population estimates, 1998 and 1999

Site	Session 1		Session 2	
	N	se(N)	N	se(N)
Walnut A, upper	8.3	0.6	4.1	0.3
Walnut A, lower	0.0	0.0	1.0	0.0
Walnut B	2.0	0.1	1.0	0.0
Walnut, lower	2.0	0.1	2.0	0.1
Rock Creek, upper	5.4	1.0	0.0	0.0
Rock Creek, lower	3.2	0.6	4.3	0.8

5.3.2 Density Estimates

Conversion of population estimates to density estimates (i.e. the number of mice found per kilometer of stream reach, regardless of the habitat width) requires an additional assumption regarding the actual area from which animals observed on the trap transects were drawn. Rocky Flats ecologists, along with those from the Colorado Division of Wildlife (CDOW), provided radio telemetry information to CSU researcher Gary White on the proportion of animals trapped on a transect that are actually residents of that transect area. From this estimate, a calculated extension could be added to the aggregated transect length (L_o in meters), to account for trapping of animals from adjacent areas. The average estimated extension was $41.5 \text{ m} \pm 9.17$ (se) on either end of each transect. This extension was used to compute the adjusted length (L_a in meters) of the stream trapped at each site by adding this boundary to either side of each transect, but not double counting areas where the boundaries of the adjacent transect overlapped. Population estimates were then divided by the adjusted length to derive the density (D) for each site. The results are shown in the table below.

Density conversion using Site and CDOW telemetry data for Walnut and Rock Creeks, 1998 and 1999

Site	L_o	L_a	p^1	se(p)	Session 1		Session 2	
					D (No./km)	se(D)	D (No./km)	se(D)
Walnut A, upper	450	553	0.814	0.027	14.9	1.08	7.4	0.53
Walnut A, lower	300	466	0.644	0.025	0.0	0.0	2.1	0.04
Walnut B	450	696	0.647	0.017	2.9	0.20	1.4	0.02
Walnut, lower	600	776	0.773	0.018	2.6	0.18	2.6	0.18
Rock Creek, upper	900	1297	0.694	0.010	4.2	0.78	0.0	0.00
Rock Creek, lower	600	932	0.644	0.013	3.5	0.65	4.7	0.87

¹ Proportion of animals trapped that are resident on the grid versus drawn from adjacent areas.

L_o = the original length. L_a = adjusted length.

Given these numbers and the length of the streams, a population estimate for Rock Creek and Walnut Creek is now possible. Prior random selection of trapping transects from all available habitat allows the entire population of each drainage to be inferred.

Results of Preble's mouse population estimates in Rock and Walnut Creeks, 1998–1999

Creek	Series	Estimate		Density (# / km)		Stream Length	Population
		Session 1	Session 2	Session 1	Session 2		
Rock	Upper	5.4 (+/-1.0)	0.0	4.2 (+/-0.8)	0.0	8.5	36 (± 7)
	Lower	3.2 (+/-0.6)	4.3 (+/-0.8)	3.5 (+/-0.7)	4.7 (+/-0.9)	4.3	35 (± 7)
Walnut	A-upper	8.3 (+/-0.6)	4.1 (+/-0.3)	14.9 (+/-1)	7.4 (+/-0.5)	0.9	20 (± 1)
	A-lower	0.0	1.0 (+/-0.0)	0.0	2.1 (+/-0.0)	0.7	2 (± 0)
	B-series	2.0 (+/-0.1)	1.0 (+/-0.0)	2.9 (+/-0.2)	1.4 (+/-0.0)	1.4	6 (± 0)
	Lower	2.0 (+/-0.1)	2.0 (+/-0.1)	2.6 (+/-0.2)	2.6 (+/-0.2)	2.5	13 (± 1)
Total						27.2km	112 (± 17)

This analysis indicates that there are no less than 112 (± 17) Preble's mice in Rock and Walnut Creeks, combining both year's worth of estimates.

5.4 Telemetry

All 19 of the Preble's mice captured during the 1999 trapping were fitted with radio collars. As was the case in 1998, some mice slipped their collars; most of these were collars that had been tied on with thread instead of using the manufacturer's standard methods for fitting collars. This experimental method of attachment was used in an attempt to relieve the mice of having expired collars remain permanently attached. Regardless of the attachment method used, most individuals fared well and were radio-tracked for the duration of the battery life of the transmitter, up to 30–35 days. Of the individuals tracked for the duration of each session, 12 Preble's mice (8 male and 4 female) were radio-tracked during the first telemetry session (22 May to 16 July), and 8 (5 males and 3 females) were tracked during the second session (25 August to 7 October). Again, one female was captured, collared, and tracked during both sessions.

5.4.1 Data Screening

More than 1,000 telemetry bearings were taken during both telemetry sessions. Of the bearings taken, 749 were used to create 224 triangulated points. The remaining bearings were discarded for numerous reasons, including:

- They were single bearings

- They represented signal bounce
- They were eliminated to reduce the size of error polygons
- They did not form usable triangulations.

The 224 triangulated points were further screened by eliminating points that had error polygons larger than 0.5 ha or that were determined not to be related to mouse movements (i.e., collars that had slipped off or remained active but on the ground after predation). The remaining points were combined with capture locations and visual observations, for a total of 263 points used in calculating Walnut Creek movement information presented here.

In the same manner, the telemetry data from Rock Creek in 1998 were screened using the original data file. Once again, the remaining points were combined with capture locations and visual observations, for a total of 181 points to use in re-calculating the Rock Creek movement endpoints.

5.4.2 Uncertainty Analysis

Based on a comparison of 10 telemetry points with corresponding visual observations (obtained within an hour after determining the telemetry point), uncertainty analyses yielded a maximum uncertainty of 70 m (230 ft). The average uncertainty was 33 m. Each telemetry point is therefore considered to be within 16.5 m (in any direction) of its computed coordinates. Recalculated Rock Creek telemetry uncertainty resulted in an average uncertainty of 29 m (95 ft).

As an additional check, all error polygons used to create the triangulated points were found to have an average radius of 13.4 m ($n=184$), with a maximum of 39.1 m. These values, converted to diameters (26.9 m and 78.2 m, respectively), are close to the uncertainty values estimated using the comparison with visual points above (33 m and 70 m, respectively), supporting the validity of the analysis. However, the uncertainty calculation with the visual observations, while using a smaller sample size, is considered to be more accurate than the error polygon radius method, because visual observation points are known to be accurate to within a meter.

5.4.3 Distribution in Walnut Creek

The 12 individuals tracked during the first session in Walnut Creek were mostly in the A-series (Figure 1). Eight individuals were tracked in the A-series, two in Lower Walnut Creek, and two in the B-series. The A-series individuals traveled widely within the habitat upstream of the A-1 pond. This habitat unit appeared to encompass most of the home ranges of all the A-series individuals during the telemetry period. These individuals did not travel to any of the other series, and only two were ever found downstream of the A-1 pond. The two mice that did travel downstream crossed over

earthen dams that had been reclaimed with grass. For a short time, these individuals traveled from above the A-1 diversion structure to the inlet of the A-2 pond. Otherwise, the distribution of the A-series mice was almost completely limited to the habitat unit above the A-1 pond, including the pond inlet (Figure 1). During the telemetry session, they did not use the upland grasslands to any great extent, but seemed to be restricted to the riparian and upland shrub vegetation types found upstream of the A-1 pond. Riparian habitat was the main travel pathway used when individuals did move. Overland travel out of the riparian zone was not observed in Walnut Creek. The wide-ranging patterns of the Rock Creek mice in 1998 (K-H 1999a) were not seen in the A-series mice.

First-session mice in the B-series and Lower Walnut Creek demonstrated the same restricted movements, with the exception of one adult female in the B-series. This individual traveled from upstream of the B-1 pond to the inlet of the B-4 pond over a 24-hour period. This is a straight-line distance of approximately 350 m. This individual was also located below the B-4 dam briefly one night. The most likely travel route was across a one-lane gravel road approximately 5 m wide.

During the second session, A-series mice demonstrated the same restricted distribution as observed during the first session. However, a new individual was captured at the A-3 pond inlet. This was the second time a mouse had been captured at this location (Ecological Database, K-H 1999b). Site ecologists believe this information reflects the distribution of mice around the three upper ponds of the A-series, with the majority of the mice inhabiting the habitat above the A-1 pond.

Second-session individuals of the B-series and Lower Walnut Creek also demonstrated the same limited distribution, with one exception. A female was captured in a transect below the Walnut Creek and McKay Ditch confluence, and subsequently was tracked downstream a total of 290 m to a suspected hibernation site. Once again, second-session individuals did not use uplands to any great extent during the telemetry period.

One other noteworthy point is that only one of the mice captured during the first session of trapping was captured again during the second. This may be an indication that the first-session individuals 1) emigrated somewhere else, 2) did not survive to the second session, or 3) became trap-shy.

Second-session mice were tracked to three different types of nests: daytime nests, a natal nest, and a probable hibernation site. Daytime nests were found in all areas trapped. They were always above ground and usually made of grass. Daytime nests were typically along the edge of shrubs, but never too far from the stream (0.5 to 10 m). One nest, at the B-4 pond, was found in cattails. This nest was only a short distance (2 m) from grassy vegetation on one side of a large cattail patch.

The natal nest was located in thickly covered shrub vegetation, coyote willow, short shrubs, and weeds. The entrance was located 1 m from the stream and about 1 m above the water level. The inner chamber was approximately 10 by 8 cm, at a depth of about

8 cm below ground level. The natal nest had five deceased young inside. The young were all fully furred, weighed about 2 g each, and were 40 mm long.

A probable hibernation site was located by tracking a female in Lower Walnut Creek. Personnel did not disturb the chamber, but the general location was found on a steep north-facing slope (approximately 40°) about 1 m from the stream. The site was covered thinly by grass and some snowberry. The entrance was plugged with dirt, and seemed to extend upward to a hibernaculum. A tunnel configuration such as this may prevent water from entering the hibernation chamber even if the burrow entrance is covered by flood-water.

5.4.4 Travel Distances

Using telemetry data points, distances traveled were computed for average and maximum movement over a 24-hour observation period, and average and maximum length of stream reach used over the telemetry session (20+ days). Additionally, the maximum perpendicular distance from the stream that a mouse was observed is reported. These reported average distances combine data points from all individuals over both sessions in Walnut and Rock Creeks (Table 3).

5.4.4.1 Walnut Creek

The average distance a mouse traveled between 24-hour observations in the first session was 57 m (187 ft; n = 98 observations). The maximum distance traveled between 24-hour observations was 386 m (1,266 ft).

The average distance a mouse traveled between 24-hour observations in the second session was 55 m (180 ft; n = 59 observations). The maximum distance traveled between 24-hour observations was 485 m (1,591 ft).

The linear stream reach used over the telemetry session (20+ days) is intended to provide an estimated length of stream used by individual mice in summer. The average distance used was 320 m (1,050 ft, 0.20 miles; n = 4) of stream during the first session and 282 m (925 ft, 0.17 miles n = 4) during the second session. The maximum distance observed over both sessions was 597 m (1,962 ft, 0.37 miles) of stream. An adult female that was captured above the B-1 pond and tracked to below the B-4 dam used this stream reach distance.

The maximum perpendicular distance away from the Walnut Creek stream channel at which an individual was observed was 68 m (223 ft). All observations were within the Walnut Creek riparian zone or adjacent to the riparian zone. There were no mice observed in drier areas such as those on top of the pediment in the xeric tallgrass prairie.

Home ranges were calculated for those collared mice that were tracked in Walnut Creek for 20 days or longer (i.e., those mice tracked in 1999). These home ranges are the result

of movements of two adult males and six adult females in summer. With the exception of one individual, these home ranges represent normal summer activities, which include foraging, resting, and breeding, calculated from observation during June/July and August/September (Figure 3b). The resulting summer home ranges that do not include movement into hibernation are presented in Table 4a and range from 0.6 to 2.8 ha (1.6 to 7.1 acres). The mean summer home range for Preble's mice in Walnut Creek is 1.5 ha (± 0.9 ; Table 4b).

The individual (number 139; Table 4a) that was the exception from a normal summer home range was a female captured in September in Lower Walnut Creek. This mouse was tracked to a hibernation site, and her calculated home range includes movement to a hibernation site and areas used during the normal summer activities of foraging and resting, but likely not breeding. The home range of this mouse is multi-modal (Figure 3a) illustrating the shift in activities from summer to hibernation. The summer activity is found upstream (left polygons), and the hibernation site is downstream.

5.4.4.2 Rock Creek

The recalculated average distance a mouse traveled between 24-hour observations in the first session was 171 m (561 ft; $n = 94$ observations). The maximum distance traveled between 24-hour observations was 940 m (3,084 ft).

The recalculated average distance a mouse traveled between 24-hour observations in the second session was 95 m (312 ft; $n = 29$ observations). The maximum distance traveled between 24-hour observations was 713 m (2,339 ft).

The linear stream reach used in Rock Creek over the 1998 telemetry session (20+ days) is intended to provide an estimated length of stream used by individual mice in summer. The average distance used was 873 m (2,864 ft, 0.54 miles; $n = 6$) of stream during the first session and 505 m (1,657 ft, 0.31 miles $n = 2$) during the second session. The maximum distance observed over both sessions was 1,492 m (4,895 ft, 0.93 miles) of stream.

The maximum perpendicular distance away from the Rock Creek stream channel at which an individual in 1998 was observed was 233 m (764 ft). All observations were within the Rock Creek riparian zone, seep wetlands, or adjacent to the riparian zone. There were no mice observed in drier areas such as those on top of the pediment in the xeric tallgrass prairie.

Home ranges were calculated for those collared mice that were tracked for 20 days or longer in 1998, although many of the mice in Rock Creek were tracked for more than 30 days. Six of these home ranges, those during the first session in 1998, are the result of movements of six adult males in summer. The remaining two individuals' movements, a male and female, result from movements prior to hibernation. The small home range of the male (0.2 ha, 0.5 acres) illustrates the declining activity just prior to hibernation. The female's home range (2.7 ha, 6.9 acres) likely illustrates the roaming that may occur in

search for a hibernation site. Overall, the resulting home ranges from normal summer activity that would include breeding, resting, and foraging are presented in Table 4a and range from 1.4 ha to 5.7 (3.6 to 14.3 acres), with a mean of 4.3 (± 1.8 ; Table 4b). These home ranges are considerably larger than those seen in the Walnut Creek area. Two examples of the home ranges from Rock Creek are presented in Figure 4a and b.

5.5 Habitat Characterization Results

Vegetation and physical measurements were made to describe some of the abiotic and biotic characteristics at successful trapping transects in new locations.

Vegetation and physical measurements were made at four transects where Preble's mice were captured in 1999, as well as at the 1999 nest sites and probable hibernaculum, to describe Preble's mouse habitat in Walnut Creek. Table 5 summarizes the vegetation and physical characteristics measured at the four transects in 1999 and compares these data to those gathered at locations in Rock Creek (1998) and Woman Creek (1997). Vegetation measurements included the number of species per trap-station, herbaceous density, and cover. The number of species per trap-station averaged approximately 14 across all four transects in 1999. Herbaceous density, a measure of horizontal vegetation cover or thickness of vegetation, averaged approximately 56 percent across the four transects sampled in Walnut Creek. Tree and shrub canopy cover, as measured with a spherical densiometer, provided approximately 24 percent cover. The woody index and herbaceous index values (both derived values—see Methods section) averaged approximately 45 and 70, respectively. The measures of distance to stream, embankment, and canopy edge averaged 1.8 m, 3.8 m, and 8 m, respectively.

Nest site and hibernaculum habitat characterization measurements are shown in Table 6. A total of eight nest sites and one hibernaculum were characterized. The number of species per trap-station averaged approximately 14 at the eight nest sites and was 21 at the single hibernaculum site. Herbaceous density averaged 42 percent at the nest sites and 12 percent at the hibernaculum site. Tree and shrub canopy cover was approximately 31 percent at the nest sites and 25 percent at the hibernaculum site. The woody index and herbaceous index values averaged approximately 45 and 65, respectively, at the nest sites. At the hibernaculum, these measurements were 30 and 66, respectively. The nest sites were located an average of 3.1 m from the stream, 2.6 m from the embankment, and 3.5 m from the canopy edge. The hibernaculum was located on an embankment only 1.2 m from the stream and 1.0 m from the canopy edge.

6. Discussion

Preble's mice were more numerous and more widely distributed than expected in Walnut Creek during the 1999 study. Mice were captured in the A-series, the B-series and the lower section of Walnut Creek. Mice were captured in the A-series not only in the habitat patch above the A-1 Pond, but also above the A-3 Pond. Additionally, two mice were observed moving from above the A-1 pond to the A-2 pond inlet. Likewise in the B-series, one mouse was captured above the B-1 pond and two mice were captured above the B-4 pond. These captures were unexpected because trapping in 1995 (DOE 1995, 1996) in similar areas indicated no mice above the B-4 Dam. However, areas of habitat do exist and have been mapped as protected areas (Figure 5), so where there is enough habitat available, Preble's mice can inhabit these areas, even if only seasonally.

Telemetry in the B-series also illustrated how Preble's mice can use a large portion of the stream reach, despite the fact that the habitat is divided by segments of ponds and dam faces. These reaches in the A- and B-series have a discontinuous distribution of habitat because of the ponds and dams. However, individuals have been tracked crossing dirt roads and grass dam faces, and moving around ponds to travel up- and downstream.

Mice were also captured in the lower section of Walnut Creek. Four individuals were captured, which is significant because Preble's mice had been captured there in 1993 (EG&G 1993), but subsequent trapping efforts did not detect any mice (DOE 1995, DOE 1996, K-H 1997). This may indicate the transitory nature of populations or groups of mice from year to year. Preble's mice have the ability to move great distances and may emigrate from area to area. Or mice may die out in an area only to have the next generation thrive in a new location.

Walnut Creek had the highest density of mice in the habitat patch above the A-1 pond. This density surpassed those estimated for the B-series, Lower Walnut Creek, and 1998 Rock Creek estimates. This area above the A-1 Pond remains important in terms of Preble's mouse conservation and likely indicates an area of very high habitat quality.

When all population estimates for the Walnut Creek drainage are combined with the length of available habitat, a total calculated population of $41(\pm 3)$ mice is estimated for Walnut Creek in 1999. This compares to a total of $71(\pm 14)$ mice in Rock Creek one year earlier, illustrating that Rock Creek, with its greater length of available habitat, can likely support a larger population than Walnut Creek can. However, caution should be used in interpreting these numbers, given the fact that Rock Creek was trapped a year earlier and populations may fluctuate from year to year. Additionally, these population numbers should be used with caution, because they are estimates—not actual numbers. Many factors, including sources of variation that we cannot completely account for, go into these calculations. In all likelihood, these values represent the lower bounds of what these habitats can support. It is evident from radio telemetry observations that:

- Not all individuals are captured
- Individuals captured once are more difficult to recapture
- Preble's mice are highly mobile creatures that are found in low numbers.

No mice were observed, through radio telemetry, to move from one section of Walnut Creek to another (e.g., from the A-series to the lower section, or from the B-series to the lower section). In fact, the overall movements of mice in Walnut Creek in terms of short-duration movement (i.e., 24-hour period), 20+ day movement, and use of adjacent habitat (i.e., distance observed perpendicular from the stream) were notably more restricted than those seen in Rock Creek in 1998; Table 3). In the relatively contiguous habitat found in Rock Creek, mice were documented to move greater distances over the short term, use a larger section of stream reach, and use areas a great distance away from the main channels of the stream (up to 233m, Table 3). These observations may indicate that the discontinuity of habitat found in Walnut Creek somewhat restricts movements of Preble's mice. The Walnut Creek riparian habitat is also considerably more linear and narrower due to the lack of hillside seeps similar to those found in Rock Creek. This difference in available habitat likely contains the mice to a narrower corridor around the stream in the Walnut Creek drainage. Or perhaps some of the ponds and associated dam faces are large enough to be a barrier to movement (e.g., the A-4 and B-5 ponds). This telemetry study does not *prove* that the terminal ponds act as barriers to movement, but the lack of observations of mice moving extensively among the different sections of Walnut Creek, especially when this type of movement was observed in Rock Creek, does indicate a need for further investigation. Barriers to movement in the Walnut Creek drainage may be an important issue to investigate in terms of closure activities. If the habitat is now somewhat disconnected and could be reconnected by creating habitat corridors, it may be possible to eventually enhance the number of individuals and genetic viability of the Walnut Creek Preble's mouse population.

Associated with the relatively restricted movement of the Preble's mice in Walnut Creek were considerably smaller home range estimates when compared to Rock Creek. On average, the Rock Creek home ranges were nearly three times larger than those in Walnut Creek (4.3 ha for summer home range in Rock Creek and 1.5 ha in Walnut Creek; Table 4b). Preble's mice in Rock Creek have hillside seep wetlands available to them, as well as the riparian shrub areas in the main Rock Creek channel. Additionally, Preble's mice have adequate and contiguous cover that allows them to travel great distances and exploit new areas within the drainage. These habitat and landscape features are not as abundant in Walnut Creek. Therefore, habitat in Walnut and Rock Creek may be of similar quality on a local level (e.g., the size of a trapping transect), but on a larger scale, the habitat in Rock Creek may be of higher quality because of its larger contiguous area and the diversity that the seep wetlands provide. Our current method of characterizing habitat does not address these issues.

The home range values for Preble's mice represent the first reported for this subspecies using radio telemetry. The fixed-kernel method was used to calculate the estimated home

ranges. This estimation method likely overestimates home range area for Preble's mice, because only a minimal number of telemetry points are available on which to estimate home range (Seaman et al. 1999). This limitation results from the short life of the transmitters (30–35 days) and manpower/logistic constraints. However, the method does provide a means of comparing areas used among individuals, and of illustrating area use within the stream drainages. Additionally, this method is particularly applicable to irregular or bi-modal home ranges, whereas elliptical estimators (Jennrich and Turner 1969) cannot accurately estimate such data sets. The fixed-kernel method is particularly useful for a species that may use multiple activity centers such as summer foraging range and fall/winter hibernation range.

It is noteworthy that the telemetry data from both drainages show home ranges of male Preble's mice that have considerable overlap, with some large home ranges almost completely containing smaller ranges. Small mammals, in general, tolerate home range overlap and can thrive in areas of high animal density (Mares and Lacher 1987). Specific to Preble's mice, this overlap may be a function of age, in that older, more established individuals have the smaller home ranges in the higher quality habitat, whereas the more wide-ranging younger individuals may need to use more area, often overlapping other's home areas, in the course of using lower quality habitat.

During the 1999 Walnut Creek monitoring, adjacent upland areas in both the A- and B-series tributaries were disturbed by remediation projects, although the disturbances did not encroach into the riparian habitat. Preble's mice had relatively restricted movement patterns in the A- and B-series tributaries, in that their movements were less on average than movements observed in Rock Creek in 1998. Although this movement restriction might otherwise have been interpreted to be a result of the construction, that is not believed to be the case, because monitoring (i.e., telemetry observations) was conducted mostly at night during the first session, and the construction was under way during the day. It does not follow that construction activities conducted only during the day would restrict mouse activity at night, particularly since it did not intrude into the habitat. Additionally, if the construction was affecting the mice, one would have expected to see movement downstream, away from the disturbance, over the course of the telemetry period (20+ days), but this also was not the case. In fact, mice were shown to move both nearer and farther away relative to the construction activities, and there is no indication that there was a correlation between the mouse movement and construction activities. Instead, it appears that by protecting the suitable habitat of the Preble's mice in Walnut Creek (Figure 5), and not allowing the construction activities to encroach or destroy habitat, the construction projects had little effect on the populations and left them intact and viable.

Vegetation and physical habitat characterization measurements in the Walnut Creek drainage during 1999 were generally all within the range of values observed previously at other Preble's mouse capture locations (transects) within the Site (Table 5). Using a one-way analysis of variance (SigmaStat 1997), the 1999 data were compared to data collected from Rock Creek in 1998 and Woman Creek in 1997. The number of species per trap-station in Walnut Creek was significantly lower than that found in either Rock

Creek or Woman Creek. This is largely related to the more disturbed condition and more uniform mosaic of adjacent plant communities found in conjunction with the riparian habitat in Walnut Creek. Short shrub cover differences were found between Walnut Creek, where large amounts of snowberry and wild rose are common, and Woman Creek, where smaller amounts of these species are found (Table 5).

Nest location characterization data showed a high similarity to general Preble's mouse habitat characterization results. Direct comparison and statistical analysis were not possible because of the differences in the spatial scale evaluated and the small number of nests found. However, like successful transects, nest locations were found in areas with high herbaceous cover and moderate woody cover, which would provide good protection from predators (Table 6). The herbaceous density and tree and shrub canopy measures were also similar to those found along the transects. No outstanding differences were noted among any of the measures.

One probable Preble's mouse hibernaculum site was evaluated during 1999. Comparison to general Preble's mouse habitat characterization results showed fairly high similarity, although caution must be used in the comparison because only one plot, analogous to a single trap-station, was sampled for the hibernaculum data. The most notable differences were for the herbaceous density and shrub cover information. Herbaceous density, a measure of horizontal vegetation cover or thickness of vegetation, was only about one-fifth of that typically found in Preble's mouse habitat, and no tall shrub cover was present at this location. In 1995, a hibernaculum was discovered near the B-4 dam area and evaluated. The data for the 1999 and 1995 hibernacula locations were compared and examined for similarities. While there are some similarities between the two locations, several differences are apparent. Both hibernacula locations were found on steep (>40 degree slope), northerly facing aspects. The same number of plant species (21) was found within a 3-m radius of the two hibernacula locations. Tree canopy was similar at both locations, with approximately 10 percent found at the 1995 location and 15 percent at the 1999 location. Shrub cover dominated the 1995 location (60 percent), whereas none was present at the 1999 location. Very little herbaceous cover was present at the 1995 location, while herbaceous cover provided nearly 65 percent cover at the 1999 location. Perhaps most significant, however, is the location of the hibernaculum in relation to the stream. The 1995 hibernaculum was found "at the toe of a steep slope, above the riparian zone, at 20 m from the stream" (K-H 1996). The 1999 hibernaculum was found approximately 1 m above the stream itself, in an embankment, and about 1 m away from the stream, well within the flood zone.

The past three years of Preble's mouse habitat characterization have examined habitat in all three major drainages on the Site and have shown the range of conditions present where Preble's mice are commonly found. In general, Preble's mouse habitat on the Site can be characterized as areas along the streams where the herbaceous vegetation (below 1 m in height) is quite dense. The habitat most often is dominated by graminoids, while also having a small to moderate amount of tree and shrub canopy. Horizontal herbaceous density is typically greater than 50 percent. Herbaceous cover (graminoids and forbs combined, measured individually) typically provides greater than 60 percent cover. Tree

and shrub cover (above 1 m in height), while often variable, typically provides approximately 20 percent (as measured with a spherical densiometer). Combined tree, shrub, and short shrub cover (measured as individual layers and combined) typically provides greater than 45 percent cover.

At this juncture, habitat characterization at the transect level across the Site appears to be fairly complete. New data sets add little to the information we already have. However, other habitat-related questions remain, such as the relative connectivity of areas and characterization of habitat at a larger scale. Additionally of interest is the characterization of habitat adjacent to the riparian areas. Now that telemetry has documented area use well away from the main stream channels, it follows that these areas should be characterized, because the mice apparently only use these adjacent habitats under certain conditions (e.g., Rock Creek adjacent areas are extensively used, while Walnut Creek areas are not). It may be that this use of adjacent uplands occurs largely when more extensive hillside wetland or side-channel riparian habitat exists.

There is a need to assess the present condition of habitat on the Site at a larger scale and in a different manner. This should entail updating the vegetation map of the Site, or at least the riparian and adjacent habitats. Many things have changed since the current version of the vegetation map was completed. Updating the vegetation map would aid other efforts within and outside of the Ecology Program, such as designation of Preble's mouse protection areas, vegetation management, and Site project impact assessments. New methods to characterize Preble's mouse habitat at larger scales should entail transects perpendicular to the stream, as well as Geographic Information System (GIS) analysis.

7. Conclusions

Preble's mice were captured in all three sections of Walnut Creek where trapping was conducted. They were captured in the A- and B-series and the lower section of the stream, with the A-series trapping yielding the most mice. Through mark-recapture analysis, a population estimate of 41 (± 3) mice in suitable habitat is reported for Walnut Creek in 1999.

By combining the trapping data of Walnut Creek with the 1998 trapping data from Rock Creek, a population estimate for Rock Creek was also computed. The estimated number of mice in suitable habitat in Rock Creek is 71 (± 14) mice.

With similar results from trapping Woman Creek in 2000, a fairly robust estimate of Preble's mice for the three main stream drainages on the Site will be possible. Due to the randomization of trapping transects within each stream and the adherence to the same sampling plan over three years, the 1998, 1999, and 2000 trapping results can be combined to yield an estimate that encompasses nearly all of the suitable habitat across the Site. This will create a robust baseline estimate against which to compare Preble's mouse populations in the future. By following the same sampling routines and revisiting trapping transects on a regular basis, the Site population can be monitored through Site closure.

Along with population estimates, a third year of studying Preble's mouse movement within the main stream drainages of the Site will be accomplished in 2000. In 1999 in Walnut Creek, Preble's mice were more restricted on average than were the mice observed in Rock Creek the previous year, both in short-term movement (a 24-hour observation period) and longer term movement (over 20 days). Preble's mice traveled approximately 56 m (184 ft; $n = 157$ observations), on average, over a 24-hour period, and 298 m (978 ft; $n = 8$ observations), on average, over the length of stream used for more than 20 days in Walnut Creek. Mice in Rock Creek in 1998 traveled approximately 133 m (436 ft; $n = 123$ observations), on average, in 24 hours, and 689 m (2,061 ft; $n = 8$ observations), on average, over the length of stream used for more than 20 days. We conclude that the more restricted movement in Walnut Creek is due at least in part to the discontinuous nature of suitable habitat, compared to that in Rock Creek. This observation implies that future improvements to the continuity of suitable habitat could enhance habitat conditions in Walnut Creek and perhaps support a larger population of Preble's mice.

Three different types of nests were found during radio telemetry activities in Walnut Creek: daytime nests, a natal nest, and a probable hibernation site. Each of these nests was constructed differently and used for different purposes. Daytime nests were found in all areas trapped. They were always above ground and usually made of grass. One nest,

at the B-4 pond, was found in cattails immediately adjacent to the stream channel, and not far from the edge of the cattails.

The natal nest was located in thickly covered shrub vegetation, coyote willow, short shrubs, and weeds. The entrance was located 1 m from the stream and about 1 m above the water level. This discovery documented that Preble's mice raise their young in below-ground chambers, but they also may use hollow logs or trees, as documented for eastern subspecies.

A probable hibernation site was located by radio tracking a female in Lower Walnut Creek. The chamber was left undisturbed by monitoring activities, but the location was characterized. The hibernaculum entrance was found on a steep north-facing slope (approximately 40°) about 1 m from the stream. The hibernaculum was located higher above the water level than the natal nest, suggesting a strategy to avoid spring flooding.

These findings add to our understanding of the Preble's mouse population at the Site and help us to better manage the habitat and avoid impacts to this federally protected species while allowing clean-up and closure projects to continue as scheduled. During the Walnut Creek study, two clean-up projects and a water diversion project were accomplished. With detailed Site knowledge of Preble's mouse habitat, enhanced by knowledge from prior monitoring of population distribution and movement patterns within Walnut Creek, Site ecologists and U.S. Fish and Wildlife Service personnel developed a strategy to lessen the impacts to the Walnut Creek Preble's mouse population while still allowing the projects to be completed. Although this study was not intended to evaluate a potential causal relation between Preble's mice and project activities, the mice were monitored during construction and were documented as remaining in the habitat areas adjacent to construction areas, and apparently unaffected by these activities. Further monitoring of the Walnut Creek Preble's mouse population in future years will confirm the continued existence of Preble's mice and facilitate additional population estimates.

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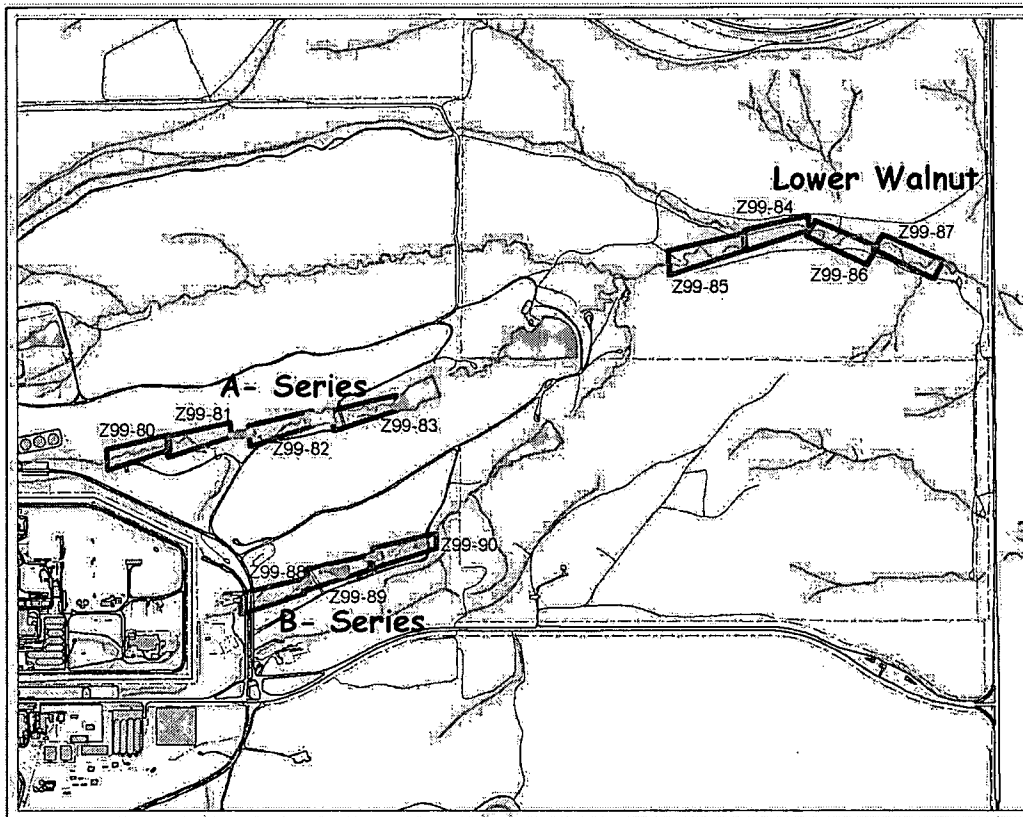
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Walnut Creek sites
sampled in 1999.

Figure 1.

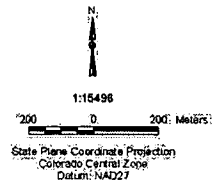
LEGEND

▣ Preble's mouse sampling area

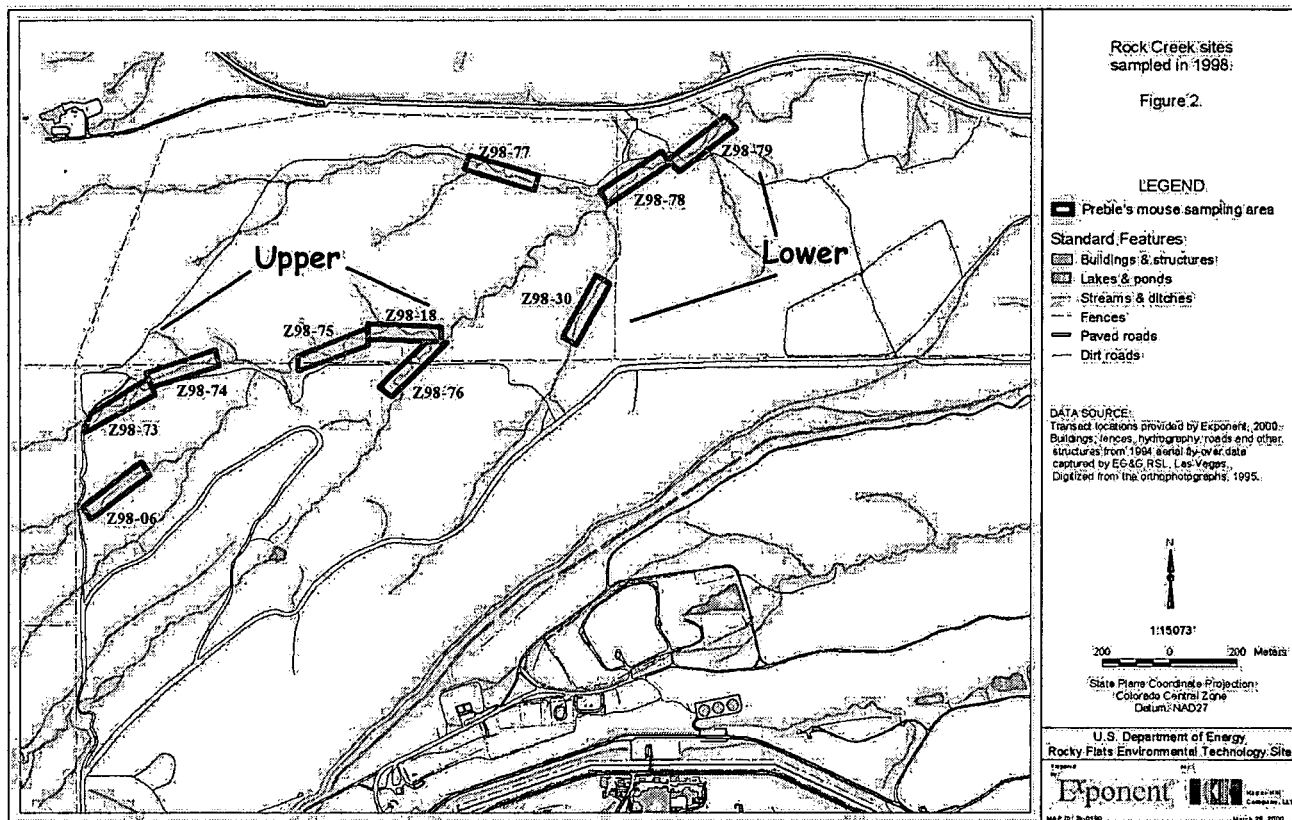
Standard Features

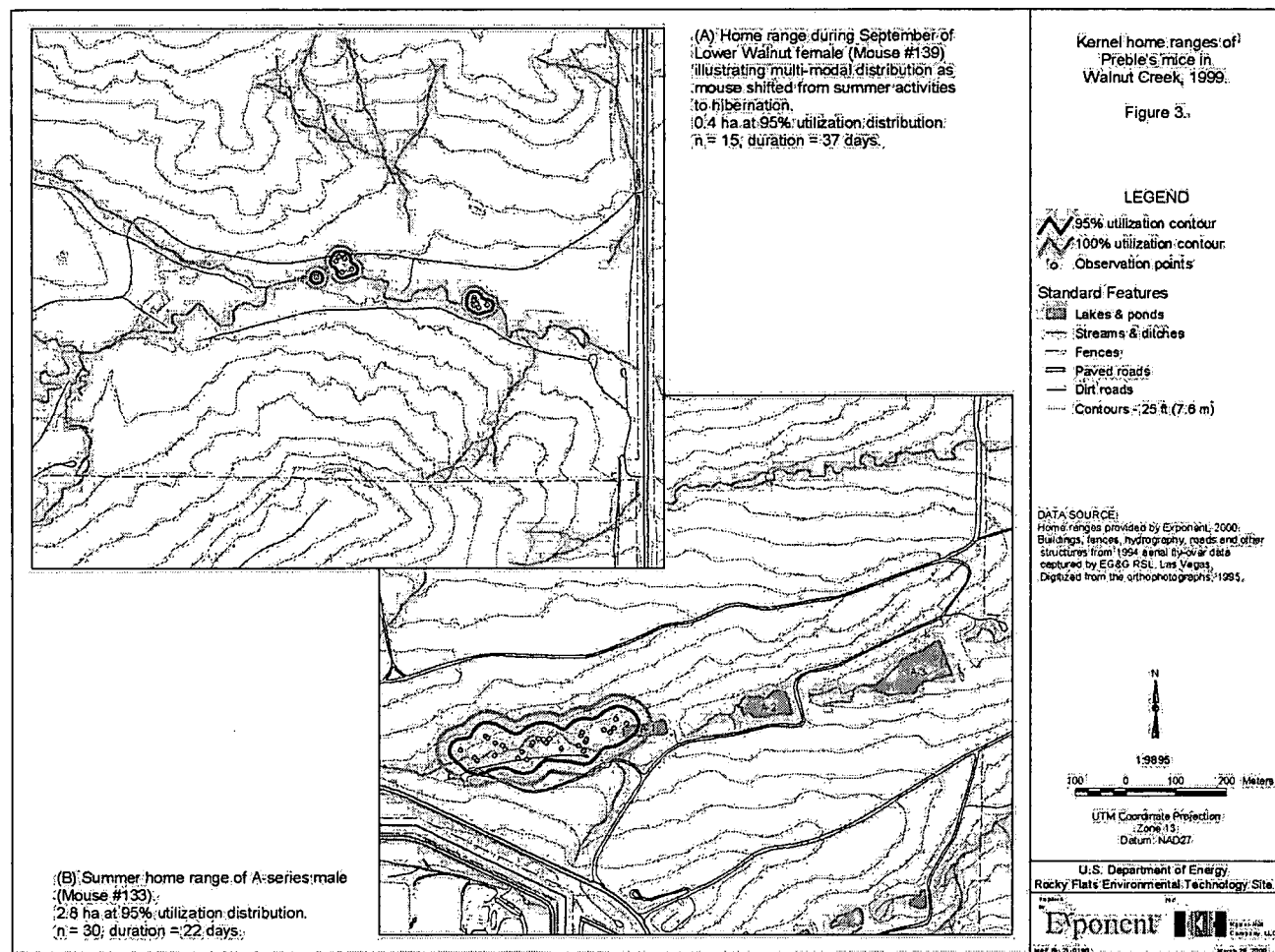
- ▣ Buildings & structures
- ▣ Lakes & ponds
- ▣ Streams & ditches
- ▣ Fences
- ▣ Paved roads
- ▣ Dirt roads

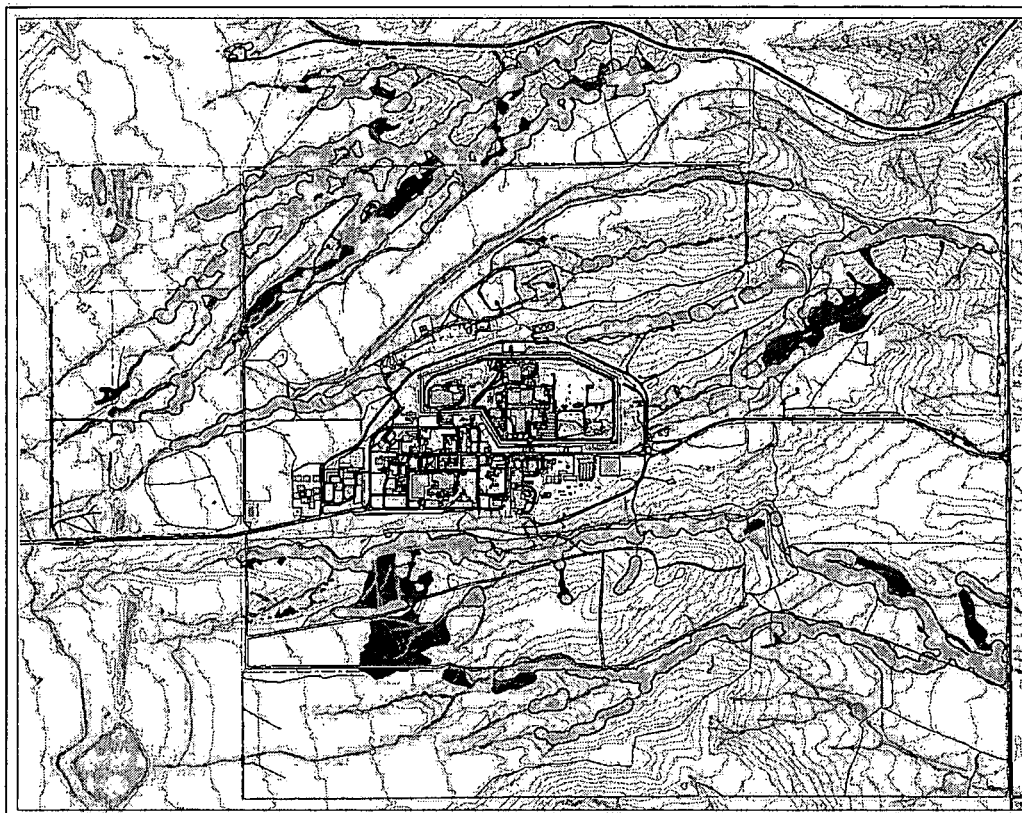
DATA SOURCE:
Transect locations provided by Eponent, 2005.
Buildings, fences, hydrography, roads and other
structures from 1994 aerial fly-over data
captured by EG&P RSL, Las Vegas.
Digitized from the orthophotographs, 1995.



U.S. Department of Energy
Rocky Flats Environmental Technology Site
Eponent
Rocky Flats Environmental Technology Site
Map # 10-100-100
March 20, 2005







Preble's mouse
protection area map
October 1999

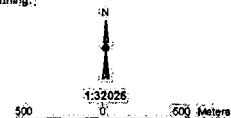
Figure 5.

LEGEND

- Protection Areas
- Contiguous Wetlands
- Standard Features:
- Buildings & structures
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours - 20 ft

DATA SOURCE:
Protection Areas and Contiguous Wetlands:
provided by USFWS
Buildings, fences, topography, roads and other
structures from 1:50,000 scale vector data
acquired by EROS PSL, Las Vegas
Digital data from topographic maps 1:50,000
Topographic data derived from digital elevation 2.5 arc
second data by Wetland Information Systems, using ESRI ArcView
and LATERAL to process the DEM data to derive 5-foot contours.
The DEM data was obtained by the Rocky Mountain Lab,
Las Vegas, NV, 1996. April. Projected at 100 meters resolution.
The DEM data processing performed by USFWS, Winter 1999.

This map is based on best current knowledge
as of October, 1999.
As research on the species continues,
this map will undergo further revision.
Be sure to use the most current map for
planning.



State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD83

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Exponent
MAP 01-01-010
10/24/99

Table 1. Capture summary, Preble's mouse trapping in Walnut Creek, 1999

<i>Peromyscus maniculatus</i>	Common Name	First Session		Second Session		Total	
		Number	Percent	Number	Percent	Number	Percent
<i>Microtus pennsylvanicus</i>	Meadow Vole	1000	48.0%	1279	59.9%	2279	54.0%
<i>Peromyscus maniculatus</i>	Deer Mouse	1043	50.1%	805	37.7%	1848	43.8%
<i>Neotoma mexicana</i>	Mexican Woodrat	12	0.6%	29	1.4%	41	1.0%
<i>Zapus hudsonius</i>	Preble's Meadow Jumping Mouse	19	0.9%	10	0.5%	29	0.7%
<i>Microtus ochrogaster</i>	Prairie Vole	6	0.3%	2	0.1%	8	0.2%
<i>Mus musculus</i>	House Mouse	0	0.0%	6	0.3%	6	0.1%
<i>Chaetodipus hispidus</i>	Hispid Pocket Mouse	0	0.0%	5	0.2%	5	0.1%
<i>Reithrodontomys megalotis</i>	Western Harvest Mouse	1	< 0.1%	1	< 0.1%	2	0.1%
not determined	unknown rodent	1	< 0.1%	0	0.0%	1	< 0.1%
Total		2082	100.0%	2137	100.0%	4219	100.0%

Note:

The first session for Walnut Creek trapping was from 20 May to 18 June (12 sites X 7 nights X 50 traps = 4,200 trap nights).

The second session for Walnut Creek trapping was from 23 August to 16 September (13 sites X 7 nights X 50 traps = 4,550 trap nights).

The total trapping effort (session 1 and 2) for Walnut Creek was 8,750 trap nights

Results include data from extra sites not used in population estimates .

Table 2. Preble's meadow jumping mouse (*Zapus hudsonius preblei*) captures in Walnut Creek, 1999

Walnut Creek						
Session	Date	Adult		Juvenile		Total Individuals
		Male	Female	Male	Female	
First	5/22/99	2				2
	6/2/99	1				1
	6/4/99		1			1
	6/10/99	1	2			3
	6/11/99	1	1			2
	6/15/99			1		1
	6/16/99	1				1
	6/17/99	1				1
	Subtotals	7	4	1	0	12
Second	8/24/99	1				1
	8/25/99	1				1
	8/26/99	1				1
	8/31/99		1			1
	9/1/99	1	1			2
	9/13/99	1				1
	Subtotals	5	2	0	0	7
Totals		12	6	1	0	19

Table 3. Summary of telemetry movement data in Walnut Creek in 1999 and Rock Creek in 1998

Walnut Creek				Rock Creek			
	METERS				METERS		
First session	Average	Max	n=	First session	Average	Max	n=
Movement between 24 hour periods	57	386	98	Movement between 24 hour periods	171	940	94
Movement per observation	56	350	176	Movement per observation	147	1045	145
20+ day movement	310	597	4	20+ day movement	873	1492	6
Perpendicular to Stream - maximum		68	12	Perpendicular to Stream - maximum		233	7
Second session				Second session			
Movement between 24 hour periods	55	485	59	Movement between 24 hour periods	95	713	29
Movement per observation	53	485	67	Movement per observation	81	713	36
20+ day movement	282	500	4	20+ day movement	505	814	2
Perpendicular to Stream - maximum		33	7	Perpendicular to Stream - maximum		187	4
Totals (Both sessions)				Totals (Both sessions)			
Movement between 24 hour periods	56	436	157	Movement between 24 hour periods	133	940	123
Movement per observation	54	418	243	Movement per observation	114	1045	181
20+ day movement	296	549	8	20+ day movement	689	1492	8
Perpendicular to Stream - maximum		68	19	Perpendicular to Stream - maximum		233	11

Table 4a. Home ranges of Preble's mice using kernel estimators (95%UD), 1998-1999

Mouse Number	Sex	Year	Session	Area (ha)	Area (acres)	Number Observations	Days Observed
126	F	1999	1	0.6	1.6	17	21
127	F	1999	1	0.8	1.9	40	36
128	F	1999	1	1.1	2.7	28	26
131	F	1999	1&2	1.9	4.6	18	28
133	M	1999	1	2.8	7.1	30	22
137	M	1999	2	2.6	6.4	13	21
138	F	1999	2	1.0	2.5	17	27
139	F	1999	2	0.4	1.0	15	37
110	M	1998	1	5.7	14.3	20	32
111	M	1998	1	1.4	3.6	10	22
112	M	1998	1	5.2	13.0	21	37
113	M	1998	1	5.3	13.2	27	35
116	M	1998	1	2.8	7.0	24	34
117	M	1998	1	5.4	13.5	31	35
118	F	1998	2	2.7	6.9	13	31
120	M	1998	2	0.2	0.5	16	33


 = Includes movement into hibernation

Table 4b. Summary of home ranges of Preble's mice at Rocky Flats, 1998-1999

Year	Area (ha)		Area (acres)		n		Days	
	mean	SD	mean	SD	mean	SD	mean	SD
1999	1.5	0.9	3.8	2.2	23.3	9.7	25.9	5.3
Total	0.4	-	1.0	-	15.0	-	37.0	-
	1.4	0.9	3.5	2.3	22.3	9.4	27.3	6.3
1998	4.3	1.8	10.7	4.4	22.2	7.2	32.5	5.4
Total	1.5	1.8	3.7	4.5	14.5	2.1	32.0	1.4
	3.6	2.1	9.0	5.2	20.3	7.1	32.4	4.6
Both years combined	2.5	1.9	6.2	4.8	21.3	8.1	29.8	6.0

Table 5. 1997, 1998, and 1999 Preble's meadow jumping mouse habitat characterization parameters

Year	1999		1998		1997			
Drainage	Walnut		Rock		Woman			
Successful (S) or Nonsuccessful (NS)	S		S		S		NS	
	Range	Mean	Range	Mean	Range	Mean	Range	NS
# Species/ Trapsite	11.80-15.90	14.30a	31.90-41.20	36.43b	20.10-32.40	26.58c	20.20-29.00	25.82c
Herbaceous Density	31.98-80.78	55.62	37.58-91.95	65.13	43.08-83.08	71.90	31.60-71.40	50.77
Tree/Shrub Canopy	11.13-44.93	23.56	2.70-34.22	14.87	0.21-58.40	24.19	0.00-34.55	10.10
Woody Index Value	34.50-66.15	45.41	25.40-79.00	45.78	29.20-85.25	66.56	6.10-78.95	30.70
Herbaceous Index Value	59.65-79.35	69.95	47.40-74.25	63.94	49.20-92.80	66.81	27.15-101.70	65.06
Tree Cover (%)	0.00-41.95	14.95	0.00-8.75	2.99	0.10-47.75	20.40	0.00-26.85	6.34
Shrub Cover (%)	2.20-20.05	12.96	13.70-72.50	29.13	25.30-65.00	41.43	0.05-46.80	20.31
SubShrub Cover (%)	11.10-25.85	17.50a	3.30-24.80	13.66ab	2.95-8.25	4.74b	0.00-8.70	4.05b
Graminoid Cover (%)	45.05-57.75	51.71	24.35-50.25	36.68	24.90-63.10	41.41	24.20-80.00	51.13
Forb Cover (%)	5.60-24.00	18.24	21.75-35.50	27.26	14.40-32.30	25.40	2.95-21.70	13.93
Slope Angle	2.70-19.20	10.53	5.90-22.8	14.43	5.90-9.60	7.00	5.00-13.60	9.60
Distance to Stream	1.53-2.20	1.82	0.50-2.14	1.26	1.09-2.08	1.58	0.79-2.26	1.60
Distance to Embankment	1.61-5.20	3.82	1.70-3.00	2.28	2.90-9.97	4.93	0.56-4.83	2.49
Distance to Canopy Edge	0.30-14.00	7.98	0.10-23.00	8.68	0.00-1.94	0.57	0.14-85.95	26.82
Sample Size (# transects)		4		4		4		5

S = Successful Sites, NS = Non-Successful Sites

All values are means. For each transect n = 10.

Different letters after the values indicate a statistically significant difference (P = 0.05). If values are followed by a different letter, they are significantly different.

Those rows without letters had no significant differences between the means.

**Table 6. 1999 Nest site and hibernaculum
habitat characterization summary**

Year	1999		1998
Drainage	Walnut		Walnut
Site Type	Nest Site		Hibernaculum
	Range	Mean	Actual Value
# Species/ Trapsite	5-35	13.50	21.00
Herbaceous Density	9.75-85.75	41.88	11.75
Tree/Shrub Canopy	0.00-76.96	30.55	24.96
Woody Index Value	NA	44.63	30.00
Herbaceous Index Value	NA	64.62	65.50
Tree Cover (%)	0.00-87.50	22.69	15.00
Shrub Cover (%)	0.00-37.50	11.25	0.00
SubShrub Cover (%)	0.00-37.50	10.69	15.00
Graminoid Cover (%)	0.00-87.50	48.81	62.50
Forb Cover (%)	1.00-87.50	15.81	3.00
Slope Angle	1-20	10.00	44.00
Distance to Stream	0.5-10.1	3.10	1.20
Distance to Embankment	0-7.1	2.64	0.00
Distance to Canopy Edge	0-11	3.50	1.00
Sample Size (# trapstations)		8	1

Attachment A

Habitat Characterization Information

Table A-1. Habitat endpoints and methods

Endpoints	Variables	Methods
Slope angle	0-90 degrees	Clinometer
Slope aspect	360 degrees	Compass
Slope position	P, T, U, M, B, R	Visual estimate
Moisture gradient	Hydric, humic, mesic, xeric	Visual estimate
Distance to stream (m)	Trap to stream edge	Meter tape
Distance to canopy edge (m)	Nearest contiguous riparian canopy does not include snowberry, rose, or shunkbush sumac	Meter tape
Habitat types	Primary, secondary, tertiary, quarternary	Use habitat codes
Trap canopy position	In, out, edge	Visual estimate
Tree and shrub canopy cover	Percent of closure (100=closed)	Spherical crown densiometer
Tree canopy species	Species code	RFETS codes
Shrub canopy species	Species code	RFETS codes
Herbaceous vertical density	Portion of m2 grid	Vegetation board
Foliar cover	Percent for tree, shrub, subshrub, grass, forb	Cover classes
Soil condition	Cobbly, gravelly, sandy, loamy, silty, clayey	Visual estimate

Table A-2. Percent cover classes

r	Solitary, with small cover
+	Few, with small cover
1	Numerous, <5% cover
2	5-25%
3	26-50%
4	51-75%
5	>75%

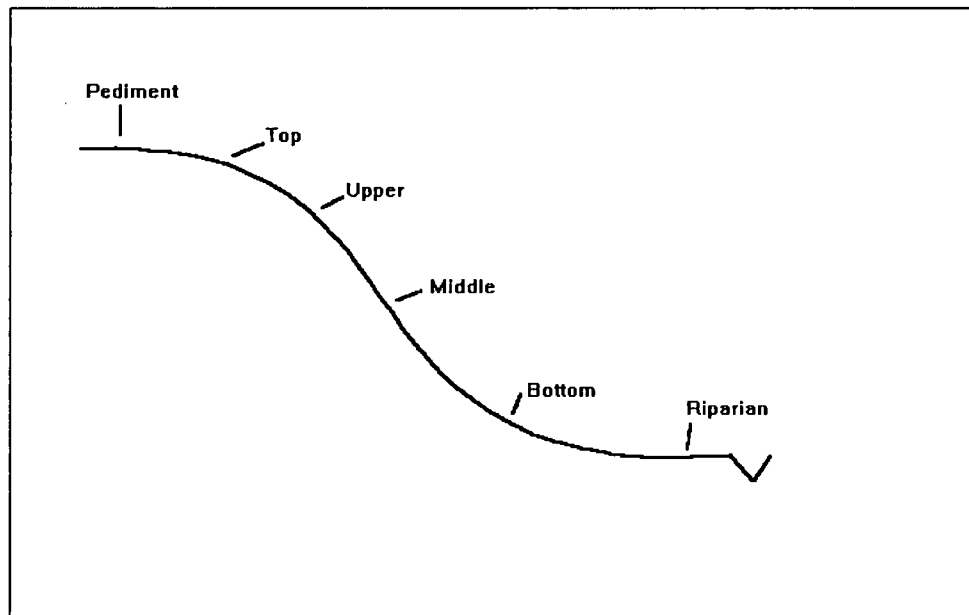


Figure A-1. Slope positions.

Appendix C

Preparation of Migratory Bird Database for Analysis, and Analytical Methodology

Preparation of Migratory Bird Database for Analysis, and Analytical Methodology

Raw data must be reduced to data summaries before it can be interpreted. To provide a more uniform summary of long-term data, some past data sets must be converted to make all data sets compatible for further analysis. This appendix describes the process by which all data sets are rendered compatible for direct comparison.

After the field data from the bird survey have been entered into the Access[®] database and quality checked, a final table must be prepared before survey-year comparisons can be made. This step is necessary to ensure the valid comparison of data sets from year to year. In the collection of bird data during this long-term ecological monitoring program, changes in observer abilities and biases appear that alter comparability to the previous years' data. This initial database conversion is designed to ensure that the analyst has the opportunity to make the data sets comparable in the face of biases in the way data have been collected from year to year.

After re-evaluation of methodology in 1997, particularly the technique for recording birds on the wing, bird survey observers started recording birds on the wing as in-habitat at 0–10 m from the centerline in linear habitat, and at 10–20 m in grasslands. During 1998 and 1999, such birds were recorded in this manner. After detailed discussions within the ecology group, it was determined that recording birds on the wing that are using the habitat in this fashion was a valid, and perhaps a more accurate representation of bird habitat use. However, in previous years, this type of observation had not been recorded in the same manner, but rather was recorded as a “flyover.” All flyovers, regardless of species or observed habitat use, were arbitrarily assigned a 100-m distance from the centerline of the transect. This arbitrary assignment of distance under-represents the habitat use of many of these bird species, so it was determined that the assigned flyover distance for previous the years (i.e., 1991–1997) should be revised to more accurately reflect habitat use by these species. These revisions for flyover records assign a distance of 0–10 m (5 m is used in analyses) for “bird on the wing” in linear habitat, and 10–20 m (15 m is used in analyses) for “bird on the wing” in grassland habitat. In the opinion of the field ecologists, the newly assigned distances represent a more realistic habitat-use weight, and more closely coincide with the way the 1998 and 1999 bird-on-the-wing data were recorded.

As a result of this re-examination of data entry methodology, the methodology has now been revised and standardized for future use. The new data summary table, created from the *Ecological Database—bird observation table*, therefore, now reflects these revisions. This new table (“Bigbird.dbf” in the Sitewide Ecological Database) is now the basis for comparisons among years of the bird survey data.

From 2000 onward, birds in flight will be recorded as either "bird on the wing" or "bird in transit," depending on whether they are actually using (i.e., feeding in) the habitat or merely passing across it. Re-examination of how the data are recorded and analyzed has produced what the ecologists feel is a more accurate way to represent habitat use by these species. Greater accuracy in data interpretation will allow better understanding of habitat use and its importance to certain species. With the newly revised data recording methodology, from 2000 forward, records of "birds on the wing" will be assigned to 5 m from the centerline of the transect if recorded in linear habitats, and assigned to 15 m from the centerline of the transect in grassland habitat. Birds in transit will be recorded, but will not be included in the habitat analyses. See Table C-1 for information on which transects are in linear habitats and which are in grasslands. Only these listed transects are used in the analyses and to compare across years.

It is apparent from past bird data analysis that the different grassland habitats, as identified by transect designations (mesic, xeric, and reclaimed), are quite similar in terms of species richness, abundance, and diversity. Therefore, these records are combined to create a general "grassland" habitat for comparisons from year to year. Similarly, the linear woody habitats (shrublands and woodlands) have also been merged for analyses. Wetland transect data must still be held separate due to the dissimilar nature of these bird communities.

Analyses performed on the prepared bird database are as follows:

- **Species richness**
 - Each year over the entire site
 - Each season for each year over the entire site
 - Each year in grassland habitats
 - Each year in woody habitats (woodland and shrubland combined)
 - Each year in wetland habitats
 - Each year in woody habitats during winter
 - Each year in woody habitats during breeding season (June)
 - Each year in grassland habitats during winter
 - Each year in grassland habitats during breeding season
 - A comparison of the above endpoints, where appropriate, using a statistical test

- Species density, as determined by the formula

$$Density = \frac{\sum N}{2(\sum \bar{D}) * \sum L * (No. Events)}$$

where,

Density = number of individuals within a species or guild per unit area (square meter)

\sum indicates a summing over all sampling events

N is the number of birds seen during a sampling event observed out to a certain distance, such as 50 m

\bar{D} = the average distances where birds were observed (set at 50 m or 100 m) times 2 for both sides of the transect (with length, creates the box size sampled)

sum of L is the combined length of all transects of the group (e.g., grasslands)

No. Events is the number of events in which this group was sampled (e.g., over a year is 15 events)

The average distance can be computed as:

$$\bar{D} = \sum \frac{d}{n}$$

where

d = distance each observation was made per sampling event

n = the number of birds seen at the particular distance per sampling event (e.g., the number of birds seen during the first week of June in grasslands)

However, for the Rocky Flats monitoring, \bar{D} is set at 50 m for most comparisons.

To convert the density value from square meters to hectares, multiply the result by 10,000.

This formula is used to compute the following densities by species or community for later comparisons across years or seasons or sampling events.

- Bird densities over the entire site

- Bird densities over the entire site during the breeding season
- Bird densities over the entire site during winter
- Bird densities over the entire site during migration season
- A comparison of the density endpoints where appropriate (includes a look at dominant species in general communities over time)
- **Community/Site Diversity (Simpson's index)**
 - Each year over the entire site
 - Each season for each year over the entire site
 - Each year in grassland habitats
 - Each year in woody habitats
 - Each year in wetland habitats
 - Each year in woody habitats during winter
 - Each year in woody habitats during breeding season
 - Each year in grassland habitats during winter
 - Each year in grassland habitats during breeding season
 - A comparison of the diversity endpoints where appropriate.

To prepare the data sets for these comparisons, the data sets from previous years (1991–1997) and data sets from 1998–1999 where the recorded observer was “TRR” were converted in the following manner:

- Table C-2 shows a list of species typically found using the habitat along bird survey transects, but which are commonly “on the wing” when observed. These currently reside in the Flyover (FO) = 100 m category in the database.
- Prior to comparison analyses, these species are given new distance-from-centerline values based on the habitats shown in Table C-1. The distance-from-centerline value becomes 5 m or 15 m, depending on habitat.
- If the transect is located in grassland habitat (xeric, mesic, or reclaimed), the species are reassigned from the “FO = 100 m” category to the 15 m (10–20 m) category.

- If the transect is located in all other habitats (wetland, woodland, shrubland—all linear), the species are reassigned from the “FO=100 m” category to the 5 m (0–10 m) category.

Once this reassignment has been completed, all observations beyond 50 m are filtered out. The resulting table is then ready for final analysis.

Table C-1. Bird survey transects with general and specific habitat types

Transect	Watershed	Length (m)	General Habitat	Linear	Specific Habitat	Code	Description
BA01A	Woman Creek	1000	Wetland	Yes	Wetland	10,020,030	Herbaceous wetland types
BA01B	Woman Creek	1000	Wetland	Yes	Wetland	10,020,030	Herbaceous wetland types
BA01R	Rock Creek	1000	Wetland	Yes	Wetland	10,020,030	Herbaceous wetland types
BD02B	Smart Ditch	1000	Grassland	No	Reclaimed	324	Reclaimed grasslands
BD03B	Smart Ditch	1000	Grassland	No	Reclaimed	324	Reclaimed grasslands
BG01B	Smart Ditch	1000	Grassland	No	Xeric	323	Xeric mixed grasslands
BG01R	Walnut Creek	1000	Grassland	No	Mesic	322	Mesic mixed grasslands
BG02A	Woman Creek	1000	Grassland	No	Mesic	322	Mesic mixed grasslands
BG02B	Walnut Creek	1000	Grassland	No	Xeric	323	Xeric mixed grasslands
BS01B	Rock Creek	1000	Woody Linear	Yes	Upland shrub	230	Tall upland (seep) shrublands
BS02B	Rock Creek	1000	Woody Linear	Yes	Upland shrub	230	Tall upland (seep) shrublands
BS03B	Smart Ditch	1000	Woody Linear	Yes	Bottomland Shrub	212	Dry riparian shrubland
BW01A	Woman Creek	1000	Woody Linear	Yes	Woodland	110,211	Riparian woodland complex
BW01B	Walnut Creek	1000	Woody Linear	Yes	Woodland	110,211	Riparian woodland complex
BW01R	Rock Creek	1000	Woody Linear	Yes	Woodland	110,211	Riparian woodland complex
BX01B	Walnut Creek	1000	Grassland	No	Xeric	323	Xeric mixed grasslands
BX01R	Rock Creek	500	Grassland	No	Xeric	323	Xeric mixed grasslands
BX02R	Rock Creek	500	Grassland	No	Xeric	323	Xeric mixed grasslands

Table C-2. Species list for birds commonly observed "in-habitat" but "on the wing"

Common Name	Genus	Species	Species Code
American Goldfinch	Carduelis	tristis	CATR1
American Kestrel	Falco	sparverius	FASP1
Barn Swallow	Hirundo	rustica	HIRU1
Brewer's Blackbird	Euphagus	cyanoccephalus	EUCY1
Broad-tailed Hummingbird	Selasphorus	platycercus	SEPL1
Brown-headed Cowbird	Molothrus	ater	MOAT1
Cliff Swallow	Hirundo	pyrrhonota	HIPY1
Common Grackle	Quiscalus	quiscula	QUQU1
Common Nighthawk	Chordeiles	minor	CHMI1
Common Snipe	Gallinago	gallinago	GAGA1
European Starling	Sturnus	vulgaris	STVU1
Horned Lark	Eremophila	alpestris	ERAL1
House Finch	Carpodacus	mexicanus	CAME2
Killdeer	Charadrius	vociferus	CHVO1
Lesser Goldfinch	Carduelis	psaltria	CAPS1
Loggerhead Shrike	Lanius	ludovicianus	LALU1
Mountain Bluebird	Sialia	currucoides	SICU1
Mourning Dove	Zenaida	macroura	ZEMA1
Northern Flicker	Colaptes	auratus	COAU1
Northern Oriole	Icterus	galbula	ICGA1
Pine Siskin	Carduelis	pinus	CAP11
Red-winged Blackbird	Agelaius	phoeniceus	AGPH1
Say's Phoebe	Sayornis	saya	SASA1
Tree Swallow	Tachycineta	bicolor	TABI1
Violet-green Swallow	Tachycineta	thalassina	TATH1
Western Kingbird	Tyrannus	verticalis	TYVE1
Western Meadowlark	Sturnella	neglecta	STNE1
Yellow-headed Blackbird	Xanthocephalus	xanthocephalus	XAXA1

Appendix D

Rock Creek Reserve Species List

Rock Creek Species Lists

Because the Rock Creek drainage is largely included within the present boundaries of the Rock Creek Fish and Wildlife Cooperative Management Area (Rock Creek Reserve), which was created in May 1999 under the auspices of an interagency agreement between the Department of Energy, Rocky Flats Field Office (DOE, RFFO) and the U.S. Fish and Wildlife Service (USFWS), the two agencies jointly manage this Reserve to preserve the ecological resources within its boundaries (Figure 1). The Kaiser-Hill Ecology Group has provided considerable ecological data to the USFWS as a basis for developing its management plan for the Reserve. This Appendix presents summary tables of species that have been observed over the past nine years during monitoring and other routine activities within the Rock Creek drainage basin.

The wildlife species richness list for the Rock Creek drainage was derived from compiling a species list from all ecological surveys, including fortuitous sightings, from 1991 through 1999. From all years and all studies, 171 wildlife species have been recorded in Rock Creek, although several of these records may have been only single observations. Wildlife species that have been recorded in the Rock Creek area are shown in Table D-1. Broken down by general taxa, there are 28 mammal species, 134 bird species, 6 herptile (reptile and amphibian) species, and 3 fish species.

In developing the plant species list for the Rock Creek drainage, only those plants that were identified to species (415 species), and confirmed against the Site's reference herbarium, are included in the species list (Table D-1). By growth form, there are 86 grass species, 283 forb species, 2 vines, 5 cacti, 22 shrubs, and 17 tree species. Of the species recorded in Rock Creek, 81% (337) are native to the area.

Table D-1. Rock Creek Reserve Wildlife Species List

Taxonomic Group	Common Name		
Fish	Fathead Minnow	Fish	
	Largemouth Bass	Fish	
	Stoneroller	Fish	
Amphibian	Boreal Chorus Frog	Herptile	Amphibian
	Northern Leopard Frog	Herptile	Amphibian
	Tiger salamander	Herptile	Amphibian
Reptile	Bullsnake	Herptile	Reptile
	Prairie rattlesnake	Herptile	Reptile
	Western Painted Turtle	Herptile	Reptile
Passerine Bird	American Crow	Bird	Passerine
	American Goldfinch	Bird	Passerine
	American Robin	Bird	Passerine
	American Tree Sparrow	Bird	Passerine
	Barn Swallow	Bird	Passerine
	Black-billed Magpie	Bird	Passerine
	Black-capped Chickadee	Bird	Passerine
	Black-headed Grosbeak	Bird	Passerine
	Black-throated Gray Warbler	Bird	Passerine
	Blue Grosbeak	Bird	Passerine
	Blue Jay	Bird	Passerine
	Blue-gray Gnatcatcher	Bird	Passerine
	Bohemian Waxwing	Bird	Passerine
	Brewer's Blackbird	Bird	Passerine
	Brewer's Sparrow	Bird	Passerine
	Broad-tailed Hummingbird	Bird	Passerine
	Brown thrasher	Bird	Passerine
	Brown-headed Cowbird	Bird	Passerine
	Chestnut-collared longspur	Bird	Passerine
	Chestnut-sided warbler	Bird	Passerine
	Chipping Sparrow	Bird	Passerine
	Clay-colored Sparrow	Bird	Passerine
	Cliff Swallow	Bird	Passerine
	Common Grackle	Bird	Passerine
	Common Nighthawk	Bird	Passerine
	Common Poorwill	Bird	Passerine
	Common Raven	Bird	Passerine
	Common Yellowthroat	Bird	Passerine
	Dark-eyed Junco	Bird	Passerine
	Downy Woodpecker	Bird	Passerine
	Eastern Kingbird	Bird	Passerine
	Eastern Phoebe	Bird	Passerine
	European Starling	Bird	Passerine
	Fox sparrow	Bird	Passerine
	Golden-crowned Kinglet	Bird	Passerine
Passerine Bird	Grasshopper Sparrow	Bird	Passerine
	Gray Catbird	Bird	Passerine
	Green-tailed Towhee	Bird	Passerine

Table D-1. Rock Creek Reserve Wildlife Species List

Taxonomic Group	Common Name		
Passerine Bird	Hairy Woodpecker	Bird	Passerine
	Horned Lark	Bird	Passerine
	House Finch	Bird	Passerine
	House Sparrow	Bird	Passerine
	House Wren	Bird	Passerine
	Lapland Longspur	Bird	Passerine
	Lark Bunting	Bird	Passerine
	Lark Sparrow	Bird	Passerine
	Lazuli Bunting	Bird	Passerine
	Lesser Goldfinch	Bird	Passerine
	Loggerhead Shrike	Bird	Passerine
	MacGillivray's Warbler	Bird	Passerine
	Marsh Wren	Bird	Passerine
	Mountain Bluebird	Bird	Passerine
	Mountain chickadee	Bird	Passerine
	Mourning Dove	Bird	Passerine
	Northern Flicker	Bird	Passerine
	Northern mockingbird	Bird	Passerine
	Northern Oriole	Bird	Passerine
	Northern Shrike	Bird	Passerine
	Orange-crowned warbler	Bird	Passerine
	Pine Siskin	Bird	Passerine
	Red-breasted Nuthatch	Bird	Passerine
	Red-winged Blackbird	Bird	Passerine
	Rock Dove	Bird	Passerine
	Rock Wren	Bird	Passerine
	Ruby-crowned Kinglet	Bird	Passerine
	Rufous Hummingbird	Bird	Passerine
	Rufous-sided Towhee	Bird	Passerine
	Sage Thrasher	Bird	Passerine
	Savannah Sparrow	Bird	Passerine
	Say's Phoebe	Bird	Passerine
	Snow bunting	Bird	Passerine
	Solitary Vireo	Bird	Passerine
	Song Sparrow	Bird	Passerine
	Swainson's Thrush	Bird	Passerine
	Tree Swallow	Bird	Passerine
	Vesper Sparrow	Bird	Passerine
	Violet-green Swallow	Bird	Passerine
	Virginia's Warbler	Bird	Passerine
	Western Kingbird	Bird	Passerine
	Western Meadowlark	Bird	Passerine
	Western Tanager	Bird	Passerine
	Western Wood-Pewee	Bird	Passerine
	White-breasted Nuthatch	Bird	Passerine
	White-crowned Sparrow	Bird	Passerine
	Willow Flycatcher	Bird	Passerine
	Wilson's Warbler	Bird	Passerine
	Yellow Warbler	Bird	Passerine
	Yellow-breasted Chat	Bird	Passerine
	Yellow-headed Blackbird	Bird	Passerine

Table D-1. Rock Creek Reserve Wildlife Species List

Taxonomic Group	Common Name		
	Yellow-rumped Warbler	Bird	Passerine
Raptor	American Kestrel	Bird	Raptor
	Bald Eagle	Bird	Raptor
	Barn Owl	Bird	Raptor
	Ferruginous Hawk	Bird	Raptor
	Golden Eagle	Bird	Raptor
	Great Horned Owl	Bird	Raptor
	Long-eared Owl	Bird	Raptor
	Merlin	Bird	Raptor
	Northern Goshawk	Bird	Raptor
	Northern Harrier	Bird	Raptor
	Peregrine Falcon	Bird	Raptor
	Prairie Falcon	Bird	Raptor
	Red-tailed Hawk	Bird	Raptor
	Rough-legged Hawk	Bird	Raptor
	Sharp-shinned Hawk	Bird	Raptor
	Short-eared Owl	Bird	Raptor
	Swainson's Hawk	Bird	Raptor
	Turkey Vulture	Bird	Raptor
Waterfowl	American Coot	Bird	Waterfowl
	American Wigeon	Bird	Waterfowl
	Black-crowned Night-heron	Bird	Waterfowl
	Blue-winged Teal	Bird	Waterfowl
	Bufflehead	Bird	Waterfowl
	Canada Goose	Bird	Waterfowl
	Cinnamon Teal	Bird	Waterfowl
	Common Merganser	Bird	Waterfowl
	Common Snipe	Bird	Waterfowl
	Double-crested Cormorant	Bird	Waterfowl
	Gadwall	Bird	Waterfowl
	Great Blue Heron	Bird	Waterfowl
	Greater Scaup	Bird	Waterfowl
	Greater Yellowlegs	Bird	Waterfowl
	Green-winged Teal	Bird	Waterfowl
	Killdeer	Bird	Waterfowl
	Lesser Scaup	Bird	Waterfowl
	Long-billed Curlew	Bird	Waterfowl
	Mallard	Bird	Waterfowl
	Redhead	Bird	Waterfowl
	Ring-billed Gull	Bird	Waterfowl
Waterfowl	Ring-necked Duck	Bird	Waterfowl
	Sandhill Crane	Bird	Waterfowl
	Semipalmated sandpiper	Bird	Waterfowl
	Sora	Bird	Waterfowl
	Virginia Rail	Bird	Waterfowl
Small Mammal	Deer Mouse	Mammal	Small
	Harvest mouse	Mammal	Small
	Hispid Pocket Mouse	Mammal	Small

Table D-1. Rock Creek Reserve Wildlife Species List

Taxonomic Group	Common Name		
	House Mouse	Mammal	Small
	Masked shrew	Mammal	Small
	Meadow Vole	Mammal	Small
	Mexican Woodrat	Mammal	Small
	Plains Harvest Mouse	Mammal	Small
	Prairie Vole	Mammal	Small
	Preble's meadow jumping mouse	Mammal	Small
	Western Harvest Mouse	Mammal	Small
Big Game			
	Elk (Wapiti)	Mammal	Big Game
	Mule deer	Mammal	Big Game
	Mule X White-tailed deer	Mammal	Big Game
	White-tailed deer	Mammal	Big Game
Midsized Mammal			
	Black-tailed prairie dog	Mammal	Midsized
	Common porcupine	Mammal	Midsized
	Eastern fox squirrel	Mammal	Midsized
	Jackrabbit species	Mammal	Midsized
	Muskrat	Mammal	Midsized
Carnivore			
	American black bear	Mammal	Carnivore
	Bobcat	Mammal	Carnivore
	Common gray fox	Mammal	Carnivore
	Coyote	Mammal	Carnivore
	Long-tailed weasel	Mammal	Carnivore
	Mink	Mammal	Carnivore
	Mountain lion	Mammal	Carnivore
	Raccoon	Mammal	Carnivore

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Cactus	<i>Coryphantha missouriensis</i> (Sweet) Britt. & Rose	Nipple Cactus	Yes
Cactus	<i>Echinocereus viridiflorus</i> Engelm.	Hedgehog Cactus	Yes
Cactus	<i>Opuntia fragilis</i> (Nutt.) Haw.	Little Prickly Pear	Yes
Cactus	<i>Opuntia macrorhiza</i> Engelm.	Twistspine Prickly Pear	Yes
Cactus	<i>Pediocactus simpsonii</i> (Engelm.) Britt. & Rose	Nipple Cactus	Yes
Forb	<i>Achillea millefolium</i> L. ssp. <i>lanulosa</i> (Nutt.) Piper	Yarrow	Yes
Forb	<i>Agrimonia striata</i> Michx.	Striate Agrimony	Yes
Forb	<i>Agrostis scabra</i> Willd.	Ticklegrass	Yes
Forb	<i>Alisma trivale</i> Pursh	American Water Plantain	Yes
Forb	<i>Allium cernuum</i> Roth	Wild Onion	Yes
Forb	<i>Allium geyeri</i> S. Wats.	Geyer's Onion	Yes
Forb	<i>Allium textile</i> A. Nels. & Macbr.	Wild White Onion	Yes
Forb	<i>Alyssum alyssoides</i> (L.) L.	Pale Alyssum	No
Forb	<i>Alyssum minus</i> (L.) Rothmaler var. <i>micranthus</i> (C. A. Mey.) Dudley	Alyssum	No
Forb	<i>Ambrosia artemisiifolia</i> L.	Common Ragweed	Yes
Forb	<i>Ambrosia psilostachya</i> DC.	Western Ragweed	Yes
Forb	<i>Ambrosia trifida</i> L.	Giant Ragweed	Yes
Forb	<i>Anemone cylindrica</i> A. Gray	Candle Anemone	Yes
Forb	<i>Anemone patens</i> L.	Pasque-flower	Yes
Forb	<i>Antennaria microphylla</i> Rydb.	Pink Pussytoes	Yes
Forb	<i>Antennaria parvifolia</i> Nutt.	Pussytoes	Yes
Forb	<i>Apocynum cannabinum</i> L.	Hemp Dogbane	Yes
Forb	<i>Arabis fendleri</i> (S. Wats.) Greene var. <i>fendleri</i>	Rock Cress	Yes
Forb	<i>Arabis glabra</i> (L.) Bernh.	Tower Mustard	No
Forb	<i>Arabis hirsuta</i> (L.) Scop. var. <i>pynocarpa</i> (Hopkins) Rollins	Rock Cress	Yes
Forb	<i>Arctium minus</i> Bernh.	Burdock	Yes
Forb	<i>Arenaria fendleri</i> A. Gray	Fendler's Sandwort	Yes
Forb	<i>Arnica fulgens</i> Pursh.	Arnica	Yes
Forb	<i>Artemisia campestris</i> L. ssp. <i>caudata</i> (Michx.) Hall & Clem.	Western Sagewort	Yes
Forb	<i>Artemisia dracunculus</i> L.	Silky Wormwood	Yes
Forb	<i>Artemisia frigida</i> Willd.	Silver Sage	Yes
Forb	<i>Artemisia ludoviciana</i> Nutt. var. <i>ludoviciana</i>	White Sage	Yes
Forb	<i>Asclepias incarnata</i> L.	Swamp Milkweed	Yes
Forb	<i>Asclepias pumila</i> (Gray) Vail	Plains Milkweed	Yes
Forb	<i>Asclepias speciosa</i> Torr.	Showy Milkweed	Yes
Forb	<i>Asclepias viridiflora</i> Raf.	Green Milkweed	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Asparagus officinalis</i> L.	Asparagus	No
Forb	<i>Asperugo procumbens</i> L.	Madwort	No
Forb	<i>Aster falcatus</i> Lindl.	Aster	Yes
Forb	<i>Aster fendleri</i> A. Gray	Fendler's Aster	Yes
Forb	<i>Aster hesperius</i> A. Gray var. <i>hesperius</i>	Panicked Aster	Yes
Forb	<i>Aster laevis</i> L. var. <i>geyeri</i> A. Gray	Smooth Blue Aster	Yes
Forb	<i>Aster porteri</i> Gray	Aster	Yes
Forb	<i>Astragalus adsurgens</i> Pall. var. <i>robustior</i> Hook.	Standing Milkvetch	Yes
Forb	<i>Astragalus agrestis</i> Dougl. ex G. Don	Field Milkvetch	Yes
Forb	<i>Astragalus canadensis</i> L.	Canada Milk-vetch	Yes
Forb	<i>Astragalus crassicaupus</i> Nutt.	Ground-plum	Yes
Forb	<i>Astragalus drummondii</i> Dougl. ex Hook.	Drummond Milkvetch	Yes
Forb	<i>Astragalus flexuosus</i> (Hook.) G. Don	Pliant Milkvetch	Yes
Forb	<i>Astragalus shortianus</i> Nutt. ex T.&G.	Short's Milkvetch	Yes
Forb	<i>Astragalus tridactylus</i> Gray	Foothill Milkvetch	Yes
Forb	<i>Barbarea vulgaris</i> R. Br.	Yellowrocket Wintercress	No
Forb	<i>Bidens frondosa</i> L.	Beggar-ticks	Yes
Forb	<i>Calochortus gunnisonii</i> S. Wats.	Sego Lily	Yes
Forb	<i>Calylophus serrulatus</i> (Nutt.) Raven	Plains Yellow Primrose	Yes
Forb	<i>Calystegia sepium</i> (L.) R. Br. ssp. <i>angulata</i> Brummitt	Hedge Bindweed	Yes
Forb	<i>Camelina microcarpa</i> Andr. ex DC.	Small-seeded False Flax	No
Forb	<i>Campanula rotundifolia</i> L.	Harebell	Yes
Forb	<i>Carduus nutans</i> L. ssp. <i>macrolepis</i> (Peterm.) Kazmi	Musk Thistle	No
Forb	<i>Castilleja integra</i> A. Gray	Orange Paintbrush	Yes
Forb	<i>Castilleja sessiliflora</i> Pursh.	Downy Paintbrush	Yes
Forb	<i>Centaurea diffusa</i> Lam.	Diffuse Knapweed	No
Forb	<i>Cerastium arvense</i> L.	Prairie Chickweed	Yes
Forb	<i>Cerastium vulgatum</i> L.	Common Mouse-Ear	No
Forb	<i>Ceratophyllum demersum</i> L.	Coontail	Yes
Forb	<i>Chenopodium album</i> L.	Lamb's Quarters	No
Forb	<i>Chenopodium berlandieri</i> Moq.	Pitseed Goosefoot	Yes
Forb	<i>Chenopodium fremontii</i> S. Wats.	Fremont Goosefoot	Yes
Forb	<i>Chenopodium leptophyllum</i> Nutt. ex Moq.	Goosefoot	Yes
Forb	<i>Chenopodium overi</i> Aellen	Overi's Goosefoot	Yes
Forb	<i>Chrysopsis fulcrata</i> Greene	Golden Aster	Yes
Forb	<i>Chrysopsis villosa</i> Pursh.	Golden Aster	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Cichorium intybus</i> L.	Common Chicory	No
Forb	<i>Cicuta maculata</i> L. var. <i>angustifolia</i> Hook.	Water Hemlock	Yes
Forb	<i>Cirsium arvense</i> (L.) Scop.	Canada Thistle	No
Forb	<i>Cirsium undulatum</i> (Nutt.) Spreng.	Wavyleaf Thistle	Yes
Forb	<i>Cirsium vulgare</i> (Savi) Ten.	Bull Thistle	No
Forb	<i>Claytonia rosea</i> Rydb.	Spring Beauty	Yes
Forb	<i>Clematis ligusticifolia</i> Nutt.	Western Clematis	Yes
Forb	<i>Collinsia parviflora</i> Dougl. ex Lindl.	Blue Lips	Yes
Forb	<i>Collomia linearis</i> Nutt.	Collomia	Yes
Forb	<i>Comandra umbellata</i> (L.) Nutt.	Bastard Toadflax	Yes
Forb	<i>Conium maculatum</i> L.	Poison Hemlock	No
Forb	<i>Convolvulus arvensis</i> L.	Field Bindweed	No
Forb	<i>Conyza canadensis</i> (L.) Cronq.	Horseweed	Yes
Forb	<i>Crepis occidentalis</i> Nutt.	Hawksbeard	Yes
Forb	<i>Cynoglossum officinale</i> L.	Hound's Tongue	No
Forb	<i>Cystopteris fragilis</i> (L.) Bernh.	Fragile Fern	Yes
Forb	<i>Dalea candida</i> Michx. ex Willd. var. <i>oligophylla</i> (Torr.) Shinn.	White Prairie Clover	Yes
Forb	<i>Dalea purpurea</i> Vent.	Purple Prairie Clover	Yes
Forb	<i>Delphinium nuttalianum</i> Pritz. ex Walpers	Blue Larkspur	Yes
Forb	<i>Delphinium virescens</i> Nutt. ssp. <i>penardii</i> (Huth) Ewan	Prairie Larkspur	Yes
Forb	<i>Descurainia pinnata</i> (Walt.) Britt.	Tansy Mustard	Yes
Forb	<i>Descurainia richardsonii</i> (Sweet) Schultz	Tansy Mustard	Yes
Forb	<i>Descurainia sophia</i> (L.) Webb ex Prantl.	Flixweed	No
Forb	<i>Draba nemorosa</i> L.	Yellow Whitlowort	Yes
Forb	<i>Draba reptans</i> (Lam.) Fern.	White Whitlowort	Yes
Forb	<i>Epilobium ciliatum</i> Raf. ssp. <i>glandulosum</i> (Lehm.) Hock & Raven	Willow Herb	Yes
Forb	<i>Epilobium paniculatum</i> Nutt.	Willow Herb	Yes
Forb	<i>Equisetum arvense</i> L.	Field Horsetail	Yes
Forb	<i>Equisetum laevigatum</i> A. Br.	Smooth Horsetail	Yes
Forb	<i>Erigeron canus</i> A. Gray	Fleabane	Yes
Forb	<i>Erigeron divergens</i> T. & G.	Fleabane	Yes
Forb	<i>Erigeron flagellaris</i> A. Gray	Fleabane	Yes
Forb	<i>Erigeron speciosa</i> (Lindl.) DC. var. <i>macranthus</i> (Nutt.) Cronq.	Oregon Fleabane	Yes
Forb	<i>Eriogonum alatum</i> Torr.	Winged Eriogonum	Yes
Forb	<i>Eriogonum jamesii</i> Benth.	James' Wild Buckwheat	Yes
Forb	<i>Eriogonum umbellatum</i> Torr.	Sulphur Flower	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Erodium cicutarium</i> (L.) L'Her.	Filaria	No
Forb	<i>Erysimum capitatum</i> (Nutt.) DC.	Western Wallflower	Yes
Forb	<i>Euphorbia dentata</i> Michx.	Toothed Spurge	Yes
Forb	<i>Euphorbia marginata</i> Pursh.	Snow-on-the-Mountain	Yes
Forb	<i>Euphorbia robusta</i> (Engelm.) Small	Spurge	Yes
Forb	<i>Euphorbia serpyllifolia</i> Pers.	Thyme-leaved Spurge	Yes
Forb	<i>Euphorbia spathulata</i> Lam.	Spurge	Yes
Forb	<i>Evolvulus nuttallianus</i> R. & S.	Evolvulus	Yes
Forb	<i>Gaillardia aristata</i> Pursh.	Blanket Flower	Yes
Forb	<i>Galium aparine</i> L.	Catchweed Bedstraw	Yes
Forb	<i>Galium septentrionale</i> Roemer & Schultes	Northern Bedstraw	Yes
Forb	<i>Gaura coccinea</i> Pursh.	Scarlet Gaura	Yes
Forb	<i>Gaura parviflora</i> Dougl.	Velvety Gaura	Yes
Forb	<i>Gentiana affinis</i> Griseb.	Northern Gentian	Yes
Forb	<i>Geranium caespitosum</i> James ssp. <i>caespitosum</i>	Common Wild Geranium	Yes
Forb	<i>Geum aleppicum</i> Jacq.	Yellow Avens	Yes
Forb	<i>Geum macrophyllum</i> Willd.	Large-leaved Avens	Yes
Forb	<i>Glycyrrhiza lepidota</i> Pursh.	Wild Licorice	Yes
Forb	<i>Gnaphalium chilense</i> Spreng.	Cotton-batting	Yes
Forb	<i>Grindelia squarrosa</i> (Pursh.) Dun.	Curly-top Gumweed	Yes
Forb	<i>Gutierrezia sarothrae</i> (Pursh.) Britt. & Rusby	Snakeweed	Yes
Forb	<i>Hackelia floribunda</i> (Lehm.) I. M. Johnst.	Large-flowered Stickseed	Yes
Forb	<i>Harbouria trachypleura</i> (Gray) C. & R.	Whiskbroom Parsley	Yes
Forb	<i>Hedeoma hispidum</i> Pursh.	Rough False Pennyroyal	Yes
Forb	<i>Helianthus annuus</i> L.	Common Sunflower	Yes
Forb	<i>Helianthus nuttallii</i> T. & G.	Nuttall's Sunflower	Yes
Forb	<i>Helianthus petiolaris</i> Nutt.	Plains Sunflower	Yes
Forb	<i>Helianthus pumilus</i> Nutt.	Sunflower	Yes
Forb	<i>Helianthus rigidus</i> (Cass.) Desf. ssp. <i>subrhomboideus</i> (Rydb.) Heiser	Stiff Sunflower	Yes
Forb	<i>Heliomeris multiflora</i> Nuttall	Showy Goldeneye	Yes
Forb	<i>Heracleum sphondylium</i> L. ssp. <i>montanum</i> (Schleich.) Briq.	Cow Parsnip	Yes
Forb	<i>Heuchera parvifolia</i> Nutt. ex T. & G.	Alumroot	Yes
Forb	<i>Humulus lupulus</i> L. var. <i>lupuloides</i> E. Small	Common Hops	Yes
Forb	<i>Hybanthus verticillatus</i> (Ort.) Baill.	Nodding Green Violet	Yes
Forb	<i>Hydrophyllum fendleri</i> (Gray) Heller	Waterleaf	Yes
Forb	<i>Hymenopappus filifolius</i> Hook. var. <i>cinereus</i> (Rydb.) I. M. Johnst.	Hymenopappus	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Hypericum perforatum</i> L.	Common St. John's-wort	No
Forb	<i>Ipomopsis spicata</i> (Nutt.) V. Grant ssp. <i>spicata</i>	Spike Gilia	Yes
Forb	<i>Iris missouriensis</i> Nutt.	Western Blue Flag	Yes
Forb	<i>Kochia scoparia</i> (L.) Schrad.	Kochia	No
Forb	<i>Kuhnia chlorolepis</i> Woot. & Standl.	False Boneset	Yes
Forb	<i>Kuhnia eupatorioides</i> L.	False Boneset	Yes
Forb	<i>Lactuca oblongifolia</i> Nutt.	Blue Lettuce	Yes
Forb	<i>Lactuca serriola</i> L.	Prickly Lettuce	No
Forb	<i>Lappula redowskii</i> (Hornem.) Greene	Stickseed	Yes
Forb	<i>Lathyrus eucosmus</i> Butters and St. John	Purple Peavine	Yes
Forb	<i>Lemna minor</i> L.	Duckweed	Yes
Forb	<i>Lepidium campestre</i> (L.) R. Br.	Field Peppergrass	No
Forb	<i>Lepidium densiflorum</i> Schrad.	Peppergrass	Yes
Forb	<i>Lesquerella montana</i> (A. Gray) Wats.	Bladderpod	Yes
Forb	<i>Leucocrinum montanum</i> Nutt.	Mountain Lily	Yes
Forb	<i>Liatris punctata</i> Hook.	Blazing Star	Yes
Forb	<i>Ligusticum porteri</i> C. & R.	Porter's Lovage	Yes
Forb	<i>Linaria dalmatica</i> (L.) Mill.	Toadflax	No
Forb	<i>Linum perenne</i> L. var. <i>lewisii</i> (Pursh.) Eat. & Wright	Blue Flax	Yes
Forb	<i>Lippia cuneifolia</i> (Torr.) Steud.	Fog-fruit	Yes
Forb	<i>Lithospermum incisum</i> Lehm.	Puccoon	Yes
Forb	<i>Lithospermum multiflorum</i> Torr.		Yes
Forb	<i>Lobelia siphilitica</i> L. var. <i>ludoviciana</i> A. DC.	Great Lobelia	Yes
Forb	<i>Lomatium orientale</i> Coult. & Rose	Wild Parsley	Yes
Forb	<i>Lupinus argenteus</i> Pursh ssp. <i>ingratus</i> (Greene) Harmon		Yes
Forb	<i>Lupinus argenteus</i> Pursh var. <i>argenteus</i>	Silvery Lupine	Yes
Forb	<i>Lycopus americanus</i> Muhl. ex Barton	American Bugleweed	Yes
Forb	<i>Lysimachia ciliata</i> L.	Fringed Loosestrife	Yes
Forb	<i>Lythrum alatum</i> Pursh.	Winged Loosestrife	Yes
Forb	<i>Malva neglecta</i> Wallr.	Common Mallow	No
Forb	<i>Marrubium vulgare</i> L.	Common Horehound	No
Forb	<i>Medicago lupulina</i> L.	Black Medick	No
Forb	<i>Melilotus alba</i> Medic.	White Sweetclover	No
Forb	<i>Melilotus officinalis</i> (L.) Pall.	Yellow Sweetclover	No
Forb	<i>Mentha arvensis</i> L.	Field Mint	Yes
Forb	<i>Mertensia lanceolata</i> (Pursh.) A. DC.	Bluebells	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Microseris cuspidata</i> (Pursh.) Sch. Bip.	False Dandelion	Yes
Forb	<i>Mirabilis hirsuta</i> (Pursh.) MacM.	Hairy Four-O'Clock	Yes
Forb	<i>Mirabilis linearis</i> (Pursh.) Heimerl	Narrowleaf Four O'Clock	Yes
Forb	<i>Mirabilis nyctaginea</i> (Michx.) MacM.	Wild Four-O'Clock	Yes
Forb	<i>Monarda fistulosa</i> L. var. <i>menthifolia</i> (Grah.) Fern.	Wild Bergamot	Yes
Forb	<i>Musineon divaricatum</i> (Pursh.) Nutt. var. <i>hookeri</i> T. & G.	Musineon	Yes
Forb	<i>Nasturtium officinale</i> R. Br.	Watercress	No
Forb	<i>Nepeta cataria</i> L.	Catnip	No
Forb	<i>Oenothera howardii</i> (A. Nels.) W. L. Wagner	Yellow Stemless Evening Primrose	Yes
Forb	<i>Oenothera villosa</i> Thunb. ssp. <i>strigosa</i> (Rydb.) Dietrich & Raven	Common Evening Primrose	Yes
Forb	<i>Onosmodium molle</i> Michx. var. <i>occidentale</i> (Mack.) Johnst.	False Gromwell	Yes
Forb	<i>Orobanche fasciculata</i> Nutt.	Broomrape	Yes
Forb	<i>Osmorhiza chiliensis</i> H. & A.	Sweet Cicely	Yes
Forb	<i>Osmorhiza longistylis</i> (Torr.) DC var. <i>longistylis</i>	Anise Root	Yes
Forb	<i>Oxalis dillenii</i> Jacq.	Gray-Green Wood Sorrel	No
Forb	<i>Oxytropis lambertii</i> Pursh.	Purple Locoweed	Yes
Forb	<i>Parietaria pensylvanica</i> Muhl. ex Willd.	Pennsylvania Pellitory	Yes
Forb	<i>Paronychia jamesii</i> T. & G.	James' Nailwort	Yes
Forb	<i>Penstemon secundiflorus</i> Benth.	Penstemon	Yes
Forb	<i>Penstemon virens</i> Penn.	Slender Penstemon	Yes
Forb	<i>Penstemon virgatus</i> Gray ssp. <i>asa-grayi</i> Crosswhite	Penstemon	Yes
Forb	<i>Phacelia heterophylla</i> Pursh.	Scorpionweed	Yes
Forb	<i>Physalis heterophylla</i> Nees	Clammy Ground cherry	Yes
Forb	<i>Physalis virginiana</i> P. Mill.	Virginia Ground Cherry	Yes
Forb	<i>Physaria vitulifera</i> Rydb.	Double Bladder-pod	Yes
Forb	<i>Plantago lanceolata</i> L.	English Plantain	No
Forb	<i>Plantago major</i> L.	Common Plantain	No
Forb	<i>Polygonum arenastrum</i> Jord. ex Bor.	Knotweed	No
Forb	<i>Polygonum convolvulus</i> L.	Wild Buckwheat	No
Forb	<i>Polygonum douglasii</i> Greene	Knotweed	Yes
Forb	<i>Polygonum hydropiper</i> L.	Water Pepper	No
Forb	<i>Polygonum lapathifolium</i> L.	Pale Smartweed	No
Forb	<i>Polygonum persicaria</i> L.	Lady's Thumb	No
Forb	<i>Polygonum ramosissimum</i> Michx.	Knotweed	Yes
Forb	<i>Polygonum sawatchense</i> Small	Knotweed	Yes
Forb	<i>Potentilla arguta</i> Pursh	Tall Cinquefoil	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	Potentilla fissa Nutt.	Cinquefoil	Yes
Forb	Potentilla gracilis Dougl. ex Hook. var. glabrata (Lehm.) C. L. Hitchc.	Cinquefoil	Yes
Forb	Potentilla hippiana Lehm.	Wooly Cinquefoil	Yes
Forb	Potentilla norvegica L.	Norwegian Cinquefoil	Yes
Forb	Potentilla paradoxa Nutt.	Bushy Cinquefoil	Yes
Forb	Prunella vulgaris L.	Selfheal	Yes
Forb	Psoralea tenuiflora Pursh.	Wild Alfalfa	Yes
Forb	Ranunculus macounii Britt.	Macoun's Buttercup	Yes
Forb	Ranunculus trichophyllus Chaix	Hairy Leaf Buttercup	Yes
Forb	Ratibida columnifera (Nutt.) Woot. & Standl.	Prairie Coneflower	Yes
Forb	Rumex acetosella L.	Sheep Sorrel	No
Forb	Rumex crispus L.	Curly Dock	No
Forb	Rumex obtusifolius L.	Bitter Dock	No
Forb	Rumex salicifolius Weinm. ssp. triangulivalvis Danser	Willow Dock	Yes
Forb	Sagittaria latifolia Willd.	Common Arrowhead	Yes
Forb	Salsola iberica Senn. & Pau.	Russian-Thistle	No
Forb	Saponaria officinalis L.	Bouncing Bet	No
Forb	Scorzonera laciniata L.	False Salsify	No
Forb	Scrophularia lanceolata Pursh.	Figwort	Yes
Forb	Scutellaria brittonii Porter	Britton's Skullcap	Yes
Forb	Sedum lanceolatum Torr.	Stonecrop	Yes
Forb	Senecio fendleri Gray	Groundsel	Yes
Forb	Senecio integerrimus Nutt.	Groundsel	Yes
Forb	Senecio plattensis Nutt.	Prairie Ragwort	Yes
Forb	Senecio spartioides T. & G.	Groundsel	Yes
Forb	Sidalcea candida Gray	White Checkermallow	Yes
Forb	Silene antirrhina L.	Sleepy Catchfly	Yes
Forb	Silene drummondii Hook.	Campion	Yes
Forb	Silene pratensis (Raf.) Godr. & Gren	White Campion	No
Forb	Sisymbrium altissimum L.	Tumbling Mustard	No
Forb	Sisyrinchium montanum Greene	Blue-eyed Grass	Yes
Forb	Smilacina stellata (L.) Desf.	Spikenard	Yes
Forb	Smilax herbacea L. var. lasioneura (Small) Rydb.	Carrion Flower	Yes
Forb	Solidago canadensis L.	Canada Goldenrod	Yes
Forb	Solidago gigantea Ait.	Late Goldenrod	Yes
Forb	Solidago missouriensis Nutt.	Prairie Goldenrod	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Forb	<i>Solidago mollis</i> Bart.	Soft Goldenrod	Yes
Forb	<i>Solidago rigida</i> L.	Rigid Goldenrod	Yes
Forb	<i>Sonchus arvensis</i> L. ssp. <i>uglinosus</i> (Bieb.) Nyman	Field Sow Thistle	No
Forb	<i>Sonchus asper</i> (L.) Hill	Prickly Sow Thistle	No
Forb	<i>Sphaeralcea coccinea</i> (Pursh.) Rydb.	Red False Mallow	Yes
Forb	<i>Stachys palustris</i> L. ssp. <i>pilosa</i> (Nutt.) Epling	Hedge Nettle	Yes
Forb	<i>Stellaria longifolia</i> Muhl. ex Willd.	Long-leaved Stitchwort	Yes
Forb	<i>Swertia radiata</i> (Kell.) O. Ktze.	Green Gentian	Yes
Forb	<i>Talinum parviflorum</i> Nutt.	Prairie Fameflower	Yes
Forb	<i>Taraxacum laevigatum</i> (Willd.) DC.	Red Seeded Dandelion	No
Forb	<i>Taraxacum officinale</i> Weber	Dandelion	No
Forb	<i>Thalictrum dasycarpum</i> Fisch. & Ave-Lall	Purple Meadow Rue	Yes
Forb	<i>Thelesperma megapotanicum</i> (Spreng.) O. Ktze.	Greenthread	Yes
Forb	<i>Thermopsis rhombifolia</i> var. <i>divaricarpa</i> (Nels.) Isely	Golden Banner	Yes
Forb	<i>Thlaspi arvense</i> L.	Field Penny Cress	No
Forb	<i>Townsendia grandiflora</i> (Nutt.)	Easter Daisy	Yes
Forb	<i>Townsendia hookeri</i> Beaman	Easter Daisy	Yes
Forb	<i>Tradescantia occidentalis</i> (Britt.) Smyth	Spiderwort	Yes
Forb	<i>Tragopogon dubius</i> Scop.	Goat's Beard	No
Forb	<i>Triodanis leptocarpa</i> (Nutt.) Nieuw.	Venus' Looking Glass	Yes
Forb	<i>Triticum aestivum</i> L.	Wheat	No
Forb	<i>Urtica dioica</i> L. ssp. <i>gracilis</i> (Ait.) Seland.	Stinging Nettle	Yes
Forb	<i>Verbascum blattaria</i> L.	Moth Mullein	No
Forb	<i>Verbascum thapsus</i> L.	Common Mullein	No
Forb	<i>Verbena bracteata</i> Lag. & Rodr.	Prostrate Vervain	Yes
Forb	<i>Verbena hastata</i> L.	Blue Vervain	Yes
Forb	<i>Veronica americana</i> (Raf.) Schwein. ex Benth.	Brooklime Speedwell	Yes
Forb	<i>Veronica anagallis-aquatica</i> L.	Water Speedwell	No
Forb	<i>Veronica peregrina</i> L. var. <i>xalapensis</i> (H. B. K.) St. John & Warren	Purslane Speedwell	Yes
Forb	<i>Vicia americana</i> Muhl. ex Willd.	American Vetch	Yes
Forb	<i>Viola nuttallii</i> Pursh.	Yellow Prairie Violet	Yes
Forb	<i>Viola rydbergii</i> Greene	Rydberg's Violet	Yes
Forb	<i>Viola scopulorum</i> (Gray) Greene	Colorado Violet	Yes
Forb	<i>Viola sororia</i> Willd.	Northern Bog Violet	Yes
Forb	<i>Xanthium strumarium</i> L.	Cocklebur	Yes
Forb	<i>Zigadenus venenosus</i> Wats. var. <i>gramineus</i> (Rydb.) Walsh ex Peck	Death Camass	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Graminoid	<i>Aegilops cylindrica</i> Host	Jointed Goatgrass	No
Graminoid	<i>Agropyron caninum</i> (L.) Beauv. ssp. <i>majus</i> (Vasey) C. L. Hitchc.	Slender Wheatgrass	Yes
Graminoid	<i>Agropyron cristatum</i> (L.) Gaertn.	Crested Wheatgrass	No
Graminoid	<i>Agropyron dasystachyum</i> (Hook.) Scribn.		Yes
Graminoid	<i>Agropyron desertorum</i> (Fisch.) Schult.	Crested Wheatgrass	No
Graminoid	<i>Agropyron griffithsii</i> Scribn. & Smith		Yes
Graminoid	<i>Agropyron intermedium</i> (Host) Beauv.	Intermediate Wheatgrass	No
Graminoid	<i>Agropyron repens</i> (L.) Beauv.	Quackgrass	No
Graminoid	<i>Agropyron smithii</i> Rydb.	Western Wheatgrass	Yes
Graminoid	<i>Agrostis stolonifera</i> L.	Redtop	No
Graminoid	<i>Andropogon gerardii</i> Vitman	Big Bluestem	Yes
Graminoid	<i>Andropogon scoparius</i> Michx.	Little Bluestem	Yes
Graminoid	<i>Aristida purpurea</i> Nutt. var. <i>longiseta</i> (Steud.) Vasey	Fendler Threeawn	Yes
Graminoid	<i>Aristida purpurea</i> Nutt. var. <i>robusta</i> (Merrill) A. Holmgren & N. Holmgr	Red Threeawn	Yes
Graminoid	<i>Bouteloua curtipendula</i> (Michx.) Torr.	Side-oats Grama	Yes
Graminoid	<i>Bouteloua gracilis</i> (H. B. K.) Lag ex Griffiths	Blue Grama	Yes
Graminoid	<i>Bouteloua hirsuta</i> Lag	Hairy Grama	Yes
Graminoid	<i>Bromus briziformis</i> F. & M.	Rattlesnake Grass	No
Graminoid	<i>Bromus inermis</i> Leyss. ssp. <i>inermis</i>	Smooth Brome	No
Graminoid	<i>Bromus japonicus</i> Thunb. ex Murr.	Japanese Brome	No
Graminoid	<i>Bromus tectorum</i> L.	Downy Brome	No
Graminoid	<i>Buchloe dactyloides</i> (Nutt.) Engelm.	Buffalo-grass	Yes
Graminoid	<i>Carex aurea</i> Nutt.	Sedge	Yes
Graminoid	<i>Carex brevior</i> (Dew.) Mack. ex Lunell.	Sedge	Yes
Graminoid	<i>Carex eleocharis</i> Bailey	Sedge	Yes
Graminoid	<i>Carex emoryi</i> Dew.	Sedge	Yes
Graminoid	<i>Carex heliophila</i> Mack.	Sedge	Yes
Graminoid	<i>Carex hystericina</i> Muhl. ex Willd.	Sedge	Yes
Graminoid	<i>Carex interior</i> Bailey	Sedge	Yes
Graminoid	<i>Carex lanuginosa</i> Michx.	Sedge	Yes
Graminoid	<i>Carex nebrascensis</i> Dew.	Sedge	Yes
Graminoid	<i>Carex oreocharis</i> Holm.	Mountain-loving sedge	Yes
Graminoid	<i>Carex praegracilis</i> W. Boott.	Sedge	Yes
Graminoid	<i>Carex scoparia</i> Schkuhr. ex Willd.	Sedge	Yes
Graminoid	<i>Carex simulata</i> Mack.	Sedge	Yes
Graminoid	<i>Carex stipata</i> Muhl.	Sedge	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Graminoid	<i>Carex vulpinoidea</i> Michx.	Fox Sedge	Yes
Graminoid	<i>Ceratochloa marginata</i> (Nees ex Stued.) Jackson	Rescuegrass	Yes
Graminoid	<i>Dactylis glomerata</i> L.	Orchardgrass	No
Graminoid	<i>Dichanthelium oligosanthos</i> (Schultz) Gould var. <i>scribnerianum</i> (Nash) G	Scribner Dichanthelium	Yes
Graminoid	<i>Echinochloa crusgallii</i> (L.) Beauv.	Barnyard Grass	No
Graminoid	<i>Eleocharis acicularis</i> (L.) R. & S.	Spikerush	Yes
Graminoid	<i>Eleocharis macrostachya</i> Britt.	Spikerush	Yes
Graminoid	<i>Eleocharis parvula</i> Link ex Boff. & Fingerbr. var. <i>anachaeta</i> (Torr.) Svens.	Spikerush	Yes
Graminoid	<i>Elymus canadensis</i> L.	Canada Wild Rye	Yes
Graminoid	<i>Festuca ovina</i> L. var. <i>rydbergii</i> St. Yves	Sheep's Fescue	Yes
Graminoid	<i>Festuca pratensis</i> Huds.	Meadow Fescue	Yes
Graminoid	<i>Glyceria grandis</i> S. Wats. ex A. Gray	Tall Mannagrass	Yes
Graminoid	<i>Glyceria striata</i> (Lam.) Hitchc.	Fowl Mannagrass	Yes
Graminoid	<i>Hordeum jubatum</i> L.	Foxtail Barley	Yes
Graminoid	<i>Juncus articulatus</i> L.	Articulate Rush	Yes
Graminoid	<i>Juncus balticus</i> Willd.	Baltic Rush	Yes
Graminoid	<i>Juncus dudleyi</i> Wieg.	Dudley Rush	Yes
Graminoid	<i>Juncus ensifolius</i> Wikst. var. <i>montanus</i> (Englm.) C. L. Hitchc.	Rush	Yes
Graminoid	<i>Juncus interior</i> Wieg.	Inland Rush	Yes
Graminoid	<i>Juncus longistylis</i> Torr.	Rush	Yes
Graminoid	<i>Juncus nodosus</i> L.	Knotted Rush	Yes
Graminoid	<i>Juncus torreyi</i> Cov.	Torrey's Rush	Yes
Graminoid	<i>Koeleria pyramidata</i> (Lam.) Beauv.	Junegrass	Yes
Graminoid	<i>Leersia oryzoides</i> (L.) Sw.	Rice Cutgrass	Yes
Graminoid	<i>Muhlenbergia montana</i> (Nutt.) Hitchc.	Mountain Muhly	Yes
Graminoid	<i>Muhlenbergia racemosa</i> (Michx.) B. S. P.	Marsh Muhly	Yes
Graminoid	<i>Muhlenbergia wrightii</i> Vasey	Spike Muhly	Yes
Graminoid	<i>Oryzopsis hymenoides</i> (R. & S.) Ricker	Indian Ricegrass	Yes
Graminoid	<i>Panicum virgatum</i> L.	Switchgrass	Yes
Graminoid	<i>Phleum pratense</i> L.	Timothy	No
Graminoid	<i>Poa compressa</i> L.	Canada Bluegrass	No
Graminoid	<i>Poa palustris</i> L.	Fowl Bluegrass	No
Graminoid	<i>Poa pratensis</i> L.	Kentucky Bluegrass	No
Graminoid	<i>Scirpus pallidus</i> (Britt.) Fern	Bulrush	Yes
Graminoid	<i>Scirpus pungens</i> Vahl	Pungent Bulrush	Yes
Graminoid	<i>Scirpus validus</i> Vahl.	Bulrush	Yes

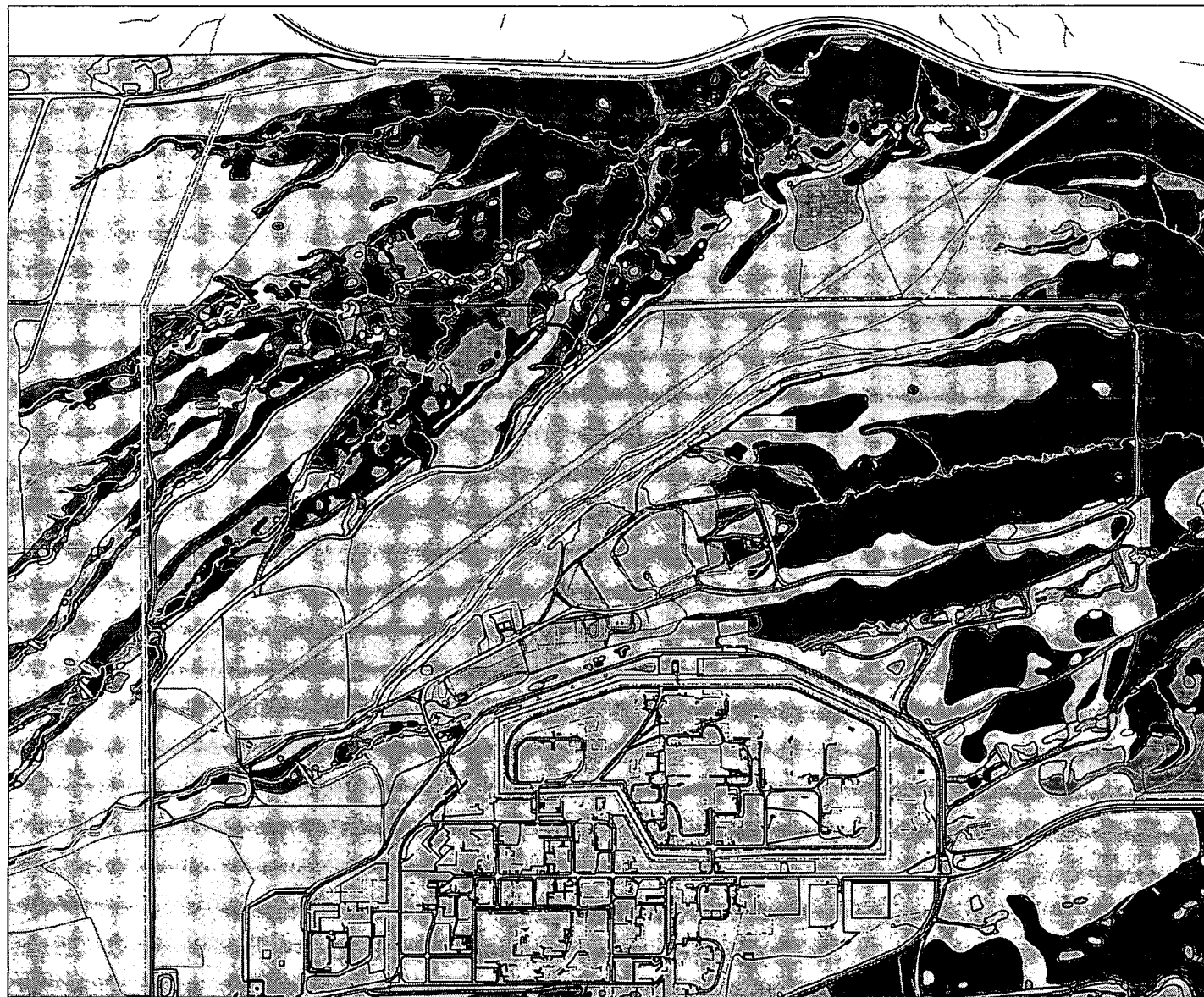
Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Graminoid	<i>Secale cereale</i> L.	Rye	No
Graminoid	<i>Sitanion hystrix</i> (Nutt.) Sm. var. <i>brevifolium</i> (Sm.) Hitchc.	Squirreltail	Yes
Graminoid	<i>Sorghastrum nutans</i> (L.) Nash	Indian-grass	Yes
Graminoid	<i>Spartina pectinata</i> Link	Prairie Cordgrass	Yes
Graminoid	<i>Sphenopholis obtusata</i> (Michx.) Scribn.	Prairie Wedgegrass	Yes
Graminoid	<i>Sporobolus asper</i> (Michx.) Kunth	Rough Dropseed	Yes
Graminoid	<i>Sporobolus cryptandrus</i> (Torr.) A. Gray	Sand Dropseed	Yes
Graminoid	<i>Sporobolus heterolepis</i> (A. Gray) A. Gray	Prairie Dropseed	Yes
Graminoid	<i>Stipa comata</i> Trin. & Rupr.	Needle-and-thread	Yes
Graminoid	<i>Stipa spartea</i> Trinius	Porcupine-grass	Yes
Graminoid	<i>Stipa viridula</i> Trin.	Green Needlegrass	Yes
Graminoid	<i>Typha angustifolia</i> L.	Narrow-leaved Cattail	Yes
Graminoid	<i>Typha latifolia</i> L.	Common Cattail	Yes
Graminoid	X <i>Agrohordeum macounii</i> (Vasey) Lepage		No
Shrub	<i>Amelanchier alnifolia</i> Nutt.	Saskatoon Service-berry	Yes
Shrub	<i>Amorpha fruticosa</i> L.	False Indigo	Yes
Shrub	<i>Berberis repens</i> Lindl.	Oregon Grape	Yes
Shrub	<i>Ceanothus herbaceus</i> Raf. var. <i>pubescens</i> (T. & G.)	New Jersey Tea	Yes
Shrub	<i>Juniperus communis</i> L.	Common Juniper	Yes
Shrub	<i>Physocarpus monogynus</i> (Torr.) Coult.	Mountain Ninebark	Yes
Shrub	<i>Physocarpus opulifolius</i> (L.) Raf.	Ninebark	Yes
Shrub	<i>Prunus pumila</i> L. var. <i>besseyi</i> (Bailey) Gl.	Sand Cherry	Yes
Shrub	<i>Rhus aromatica</i> Ait. var. <i>trilobata</i> (Nutt.) A. Gray	Fragrant Sumac	Yes
Shrub	<i>Ribes aureum</i> Pursh	Golden Currant	Yes
Shrub	<i>Ribes cereum</i> Dougl.	Western Red Currant	Yes
Shrub	<i>Rosa acicularis</i> Lindl.	Prickly Wild Rose	Yes
Shrub	<i>Rosa arkansana</i> Porter	Prairie Wild Rose	Yes
Shrub	<i>Rosa woodsii</i> Lindl.	Western Wild Rose	Yes
Shrub	<i>Rubus idaeus</i> L. ssp. <i>sachalinensis</i> (Levl.) Focke var. <i>sachalinensis</i>	Raspberry	Yes
Shrub	<i>Salix exigua</i> Nutt. ssp. <i>interior</i> (Rowlee) Cronq.	Sandbar Willow	Yes
Shrub	<i>Salix irrorata</i> Andersson	Willow	Yes
Shrub	<i>Salix lutea</i> Nutt.	Yellow Willow	Yes
Shrub	<i>Symphoricarpos occidentalis</i> Hook.	Western Snowberry	Yes
Shrub	<i>Symphoricarpos oreophilus</i> Gray	Snowberry	Yes
Shrub	<i>Viburnum opulus</i> L. var. <i>americanum</i> Ait	Highbush Cranberry	No
Shrub	<i>Yucca glauca</i> Nutt.	Yucca	Yes

Table D-2. Rock Creek Reserve Plant Species List.

Form	Scientific Name	Common Name	Native
Tree	<i>Acer glabrum</i> Torr.	Mountain Maple	Yes
Tree	<i>Acer negundo</i> L. var. <i>interius</i> (Britt.) Sarg.	Box-elder	Yes
Tree	<i>Betula occidentalis</i> Hook.	Water Birch	Yes
Tree	<i>Crataegus erythropoda</i> Ashe	Hawthorne	Yes
Tree	<i>Crataegus succulenta</i> Link var. <i>occidentalis</i> (Britton) E. J. Palm.	Hawthorn	Yes
Tree	<i>Juniperus scopulorum</i> Sarg.	Rocky Mountain Juniper	Yes
Tree	<i>Pinus ponderosa</i> Laws	Ponderosa Pine	Yes
Tree	<i>Populus alba</i> L.	Silver Poplar	Yes
Tree	<i>Populus angustifolia</i> James	Narrow-leaved Cottonwood	Yes
Tree	<i>Populus deltoides</i> Marsh. ssp. <i>monilifera</i> (Ait.) Eckenw.	Plains Cottonwood	Yes
Tree	<i>Populus x acuminata</i> Rydb.	Lanceleaf Cottonwood	Yes
Tree	<i>Prunus americana</i> Marsh.	Wild Plum	Yes
Tree	<i>Prunus virginiana</i> L. var. <i>melanocarpa</i> (A. Nels.) Sarg.	Chokecherry	Yes
Tree	<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Douglas-Fir	Yes
Tree	<i>Pyrus malus</i> L.	Apple	No
Tree	<i>Salix amygdaloides</i> Anderss.	Peach-leaf Willow	Yes
Tree	<i>Ulmus pumila</i> L.	Siberian Elm	No
Vine	<i>Toxicodendron rydbergii</i> (Small) Greene	Poison Ivy	Yes
Vine	<i>Vitis riparia</i> Michx.	River-bank Grape	Yes

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Vegetation community types of the Rock Creek Reserve.

Figure 1.

LEGEND

- Rock Creek Reserve boundary
- Vegetation community types
 - Annual Grass/Forb Community
 - Disturbed and Developed Areas
 - Leadplant Riparian Shrubland
 - Mesic Mixed Grassland
 - Mudflats
 - Open Water
 - Ponderosa Woodland
 - Reclaimed Mixed Grassland
 - Riparian Woodland
 - Riprap, Rock, and Gravel Piles
 - Savannah Shrubland
 - Short Grassland
 - Short Marsh
 - Short Upland Shrubland
 - Tall Marsh
 - Tall Upland Shrubland
 - Tree Plantings
 - Wet Meadow/Marsh Ecotone
 - Willow Riparian Shrubland
 - Xeric Needle and Thread Grass Prairie
 - Xeric Tallgrass Prairie
- Standard Features
 - Dirt roads
 - Paved roads
 - Streams & ditches
 - Fences

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 DATA SOURCE:
 Buildings, fences, hydrography, roads and other
 structures from 1994 aerial fly-over data
 captured by EG&G RSL, Las Vegas.
 Digitized from the orthophotographs, 1/95
 1:12945
 1000 0 1000 Feet
 State Plane Coordinate Projection
 Colorado Central Zone
 Datum: NAD27

U.S. Department of Energy
 Rocky Flats Environmental Technology Site

Prepared by: **Exponent**
 For: **Kaiser-Hill Company, LLC**

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